

A Conversational Computer Character to Help Children Write Stories

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Submitted to the Program in Media Arts and Sciences
School of Architecture and Planning
in partial fulfillment of the requirements for the degree of
Master of Science in Media Arts and Sciences
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ABSTRACT

A conversational computer character may improve students' story writing processes in ways existing software cannot. Writing stories is of great benefit to elementary students, but several factors make story writing difficult. Children comfortable with the interchange of spoken dialog cannot write as fluently without a tangible audience and the usual responses that support conversation. Software that allows a child to converse with a character could be an amusing and engaging way to help stimulate the production of stories. The conversational framework can provide a way for children to begin writing on the computer in a comfortable mode that is familiar from oral discourse and offers the additional support another speaker provides. A computer character with motivation and personality can also provide an example audience during the writing process.

To test whether story assistance software with a conversational computer character can be more educationally effective than software lacking such a character, two Macintosh programs were developed: EddieEdit, employing a conversational character who talks about planning and revision; and StoryStages, which offers identical planning and revision tips but without a conversational character. A two-week study tested both the usability of these programs and whether their educational interventions were effective. The story writing of three groups, one using EddieEdit, one StoryStages, and one a word processor, was compared. During the short time of the study there was little discernible improvement in writing ability and no statistically significant difference in improvement between the three groups, based on what they had written. Thus, examination of stories written at the beginning and end of the study did not provide support for the hypothesis. Answers on a final questionnaire did indicate that EddieEdit users had greater awareness of the writing process than those who used StoryStages, supporting the hypothesis. After the study both pieces of software were improved based on how the software was used by children in the study, and a Web version of Eddie was developed.

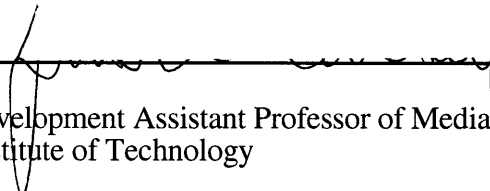
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INTRODUCTION

WHY CHILDREN SHOULD WRITE STORIES

The value of narrative writing is understood by many teachers, but sometimes an activity such as story writing can seem more fun than useful. Writing stories is, however, a meaningful educational activity. Story writing has several advantages for children, even when compared to oral storytelling or to other forms of writing, such as writing persuasive or informative essays.

Tompkins questioned educators who taught story writing to find out why they thought such writing was beneficial. The seven educators she spoke to each discussed a different way in which they thought story writing helped students. They believed story writing:

- is entertaining for children
- fosters artistic expression, as do art and music classes
- allows children to explore the functions and values of writing
- stimulates children's imaginations
- offers a way for children to clarify and refine their thinking
- provides "a step towards personal discovery and mastery"
- is an interesting way to teach reading and writing

They also described other benefits. These include giving children a sense of pride about the stories they create (Tompkins 1982). The creative act of writing a story, in which the child invents the whole world of the story, makes stories particularly satisfying to create. In writing stories, the child goes through a process that itself is the greatest educational reward, but there is also a product, the finished story, that can be shared and enjoyed in the future.

Dehouske, working with emotionally troubled children, found that for both typical and atypical children, "[p]ractice in responding innovatively and exploring alternate strategies are critical activities in cognitive development that can help students develop a thoughtful approach to their daily experience. Story writing is one activity that provides such practice" (Dehouske 1982). Cowie describes several linguistic, cognitive, social, and emotional benefits from story writing, which allows children to distance themselves from events and deal with them in new ways by re-casting them symbolically in creative narrative. Psychoanalysts have suggested this facilitates not just problem-solving development but the resolution of emotional conflicts as well (Cowie 1984).

A more extreme view of the role of stories in human cognition is held by the artificial intelligence pioneer and educational thinker Roger Schank. He contends that stories are the basis of memory and learning.

Human memory is story-based. Our knowledge of the world is more or less equivalent to the set of experiences that we have had, but our communication is limited by the number of stories we know to tell. ... we come to rely upon our own stories so much that it seems all we can tell ourselves are our stories as well. (Schank 1990, 12)

Whether or not the story is the single essential unit of cognition, Schank's work and that of his predecessors (Bartlett 1932) demonstrates that stories almost certainly have a central role in the way people make sense of the world. Creative writing can be an important part of improving these cognitive fundamentals. For Schank, true facility with storytelling includes the ability to re-tell and understand cultural and personal stories, but also being able to invent fictional stories.¹

Stories are also important to the personal development of the child, as an individual and as part of a culture. "There may be a special affinity between narrative and self such that narrative can be said to play a privileged role in the process of self-construction." (Miller et al. 1990). This sort of development of self often depends upon the telling of personal stories and the retelling of cultural stories. By creating stories, children can develop a facility with story that improves such tellings and retellings. They can also find creative new ways to express their feelings and thoughts.

Children who write stories in the classroom have an opportunity to gain linguistic benefits and improve their cognitive development by working with stories. The benefits of story writing described above indicate that it is an important form of writing and should have a place in the grade 2-5 classroom. While other activities can provide some of the individual benefits realized by story writing, the combination of advantages makes the activity particularly worthwhile for children, both in the classroom and outside school.

HOW A CONVERSATIONAL COMPUTER CHARACTER MAY HELP

A computer character may particularly aid in story planning and revision mainly because it can uniquely address certain barriers in moving from oral to written discourse. An additional benefit of such a character is that a conversational interface can be a good way for children to access information about planning and revision. Finally, a character can be a fun addition to story writing software that does not distract from the writing task.

Two problems encountered by young writers in grades 2-5 are not dealt with by existing software. First, children writing at length lack the usual conversational support that comes from the other participants in the conversation. For instance, a person listening to a story indicates verbally and nonverbally whether the teller is explaining in enough detail, or in

¹ While Schank clearly would agree with the ideas that motivate this project, he probably would not believe the type of conversational character described in this paper is worth developing. He holds that conversational systems without understanding can do no more than reveal the gullibility of computer users (Schank and Childers 1984).

too much detail. These cues are absent in writing. Second, again in distinction to spoken conversation, it is hard for young writers to imagine who exactly is the audience for the story being written. Children speak differently, for instance, depending upon whether they are addressing a sibling or a teacher, but their audience for a composition is not present to signal which type of language is appropriate. These problems are clearly related but can be distinguished, since a particular child may have less of a problem with one aspect of the transition from speaking to writing than with the other. These two issues are discussed in greater depth under the heading *The Transition from Conversation to Composition* in the Background section.

A conversational character is particularly appropriate to deal with these two difficulties in moving from spoken interaction to writing. By simulating conversation on the screen, the computer supplies the turn-taking behavior that is familiar from oral conversation. By taking a particular role as an interactive character, the system provides an immediate audience. Independent of the ability to offer help on story planning or revision, this mode of conversational interaction and the identity of the computer character can assist story writing.

A character, compared to a checklist, is also well-suited to providing the writer with greater flexibility in planning a story. A computer character provides a multilinear way of going through story elements, not a unilinear list of prompts. The writer can progress through all of the story planning steps, but in the desired order. One writer might choose to think about character in depth before describing the plot, while another may plan in the opposite order. This advantage is not unique to a conversational character — it could also be provided by a hypertext system or a hierarchical menu — but it is an advantage over a simple paper or computerized checklist.

The inclusion of a computer character helper can also simply be fun for the children using the software. A computer character can be an amusing and engaging interface that makes writing on the computer more enjoyable and novel, without distracting from the central task of writing. Unlike the multimedia components found in existing children's writing software, a conversational character can manifest itself mainly in text and can encourage writing and written interaction during planning and revision.

TESTING A CONVERSATIONAL CHARACTER'S EFFECTIVENESS WITH EDDIEEDIT

To determine whether a conversational computer character is educationally effective, and to show what such a character might be like, software was developed for use in a study. In the study, three groups of students used different software: a word processor; a prompting system that led students through planning, writing, and revising without a character; and a similar system with a conversational character. The study lasted two weeks, and the stories children wrote throughout that time were examined to determine how the students might have improved their writing skills.² They were also asked questions before and after the

² Sample interactions with StoryStages and EddieEdit, including some stories written with these programs, are included in Appendix B.

study to determine how they liked the software and how their thinking about the writing process had changed.

The main piece of software developed in this project is EddieEdit.³ This program features Eddie, a conversational computer character who aids children in writing stories. Eddie has limited understanding but was created to have personality, motivation, and identity. Eddie is himself a elementary student, and offers help as a peer. EddieEdit supports the process of planning, writing, and revising, by offering conversations with Eddie during planning and revision and allowing the child to engage in writing without interruption. After the study, the program was improved based on comments from students and on observation of how it was used, so a better version could be made publicly available. EddieEdit is a simple but fully functional first step into a new way of assisting young story writers: providing conversational and character-based educational interventions.

³ A slightly improved Web version of Eddie in which online users can plan stories was also developed. The Web implementation of Eddie is not integrated directly into word processing software. StoryStages, a list-based system for story planning and revision, was also developed in the course of this project. StoryStages was mainly created to serve as a basis for empirical evaluation of the effectiveness of EddieEdit's conversational computer character. However, further development of StoryStages was done based on usability results from the study, to create a useable and stable version of that program as well.

BACKGROUND

FROM ORAL CONVERSATION TO WRITTEN COMPOSITION

Children who can converse well and have the ability to write still have difficulty composing long stories by themselves. There are several reasons for this difficulty in moving from oral conversation to extended written narrative. The main innovation discussed in this paper is designed to address two of these barriers. These problems are the lack of conversational support in writing and the absence of an immediate audience for one's discourse.

In solitary writing, the child lacks the familiar turn-taking structure of conversation, and the supports offered by the other person or people in the conversation.

When people converse they help each other in numerous, mostly unintentional ways. They provide each other with a continual source of cues — cues to proceed, cues to stop, cues to elaborate, cues to shift topics, and a great variety of cues that stir memory. ... In written composition, all these supports are removed. (Bereiter and Scardamalia 1982)

Fortunately, the distinction between conversational storytelling and story writing is not as severe as the distinction between a discussion and an essay. In conversation, the rare occurrence of a lengthy, mostly uninterrupted section of talk for a single speaker is often a story. Stories usually span several utterances and require that the teller take over the conversation temporarily (Sacks 1970). So children have more of a conversational antecedent for this type of writing than they do for essay writing. This makes story writing a good way to bridge the gap between conversation and other forms of writing that have less connection to oral communication.

However, even in the conversational story there are frequent interruptions to provide backchannel feedback, request clarification, and express interest or distraction. There are many types of conversational support from the listeners when stories are told in conversation (Polanyi 1989). If a story is unclear it can be clarified afterwards, or listeners can ask questions during the telling of the story. There is no such opportunity in writing. When children in grades 2-5 tell stories to adults, they usually do not require the step-by-step prompting that younger children do. Still, they are aided substantially by the adult in telling their story. Even an adult speaker telling a conversational story is helped along and motivated by feedback, cues, comments, and questions. While story writing is a good first step to more extended writing, it is not without challenges. Skill at writing stories involves more than simply the combination of oral storytelling skill and writing ability.

Another difficulty for young story writers is that the audience for whom one is writing is not immediately clear, as it is when speaking to someone. The writer and reader do not share the same physical or textual context, as interlocutors do. So in addition to lacking the

interaction of conversation, the writer also lacks the clear idea of whom the communication is directed to.

The linguistic and cognitive demands of writing are much more exacting than oral discourse. Without the supportive prompts of a conversation and its ambient context, the writer has to sustain a coherent discourse, by retrieving and organizing information for an envisaged reader, in an appropriate mode and style. (Martlew 1986).

This change has several repercussions. Questions, replies, and assessment of agreement or disagreement occur in writing only “as echoes of the forms of the spoken language.” Assumptions of shared knowledge can be violated when an unanticipated party sees one’s writing, a situation which happens much less frequently in spoken conversation. So writers cannot assume as much knowledge on the part of their audiences.

Spoken texts may leave information implicit because the speaker knows what the hearer knows and because he can assess as he speaks whether he has been correct in his assessment. Hence writing tends to be marked by greater explicitness and elaboration than speaking... (Kress 1982)

Even very young children speak differently to different audiences. By age four, numerous studies have shown that children clearly do adapt their speech to the listener (Menig-Petersen, 1975; Sachs and Devin, 1975; Waterson and Snow, 1978; Anderson and Prosser 1993). Children’s ability to consider their listener is well-developed by the time they reach grade 2. Not having the necessary cues to distinguish who the audience for writing might be makes for one additional difference between speaking and writing, and creates one more barrier to writing a lengthy composition.

The stories that children write, as opposed to other forms of speech and writing, may depend less on the intended audience and be less inhibited by this problem. At age 11, children do little to distinguish the stories they write for children from those written for adults, only using “once upon a time” much more frequently as a beginning (Martlew 1986). Although children do not write fundamentally different stories, they are clearly aware that distinct reading audiences each require appropriate types of writing. For these reasons, story writing might be a good starting point that can allow children to deal with an absent audience. In grades 2-5, the lack of an immediate audiences is noticeable, but the inability to imagine the audience and adapt to the reader’s needs does not inhibit story writing. This could make story writing a good exercise in which the concept of audience can be introduced.

THE WRITING PROCESS

The software developed in this project is based on the notion that planning, writing, and revision of stories are separate processes within the broader writing process. Writing instruction can therefore focus on a particular process. This project takes this three-part categorization of writing as a foundation. The point of this project is not to evaluate the effectiveness of an approach that focuses on planning, writing, and revision. The conversational computer character, not the segmentation of the writing process, is the main feature being analyzed. The conversations that the user and the character have are based on

this segmentation of writing process, however, and this framework is essential to the software's design. So it is important to justify the separation into these three processes as appropriate and useful in writing education.

The three processes of writing (along with a fourth process, evaluation) are widely used in the teaching of story writing. Education at all age levels and in all types of writing, in fact, employs this segmentation of the writing process. This allows interventions to be focused on one particular process at a time (Huntley 1986, Daiute 1985a). Gathering ideas about the main story elements usually occurs during the time before writing. Focus on writing without distraction from brainstorming or proofreading is important when the story is actually being set down. After this has been done, additional changes and additions can focus mostly on clarity and style rather than major high-level revision. When a high school writer is engaged in the first process of planning, that writer thinks about broader ideas that form the topics of paragraphs, for instance. During writing it is useful to focus instruction on the sentence level. During the revision process, writers can improve if they think about the individual words and about what may have been left out in between sentences. By creating appropriate educational interventions for each of these processes, instruction can help people improve as story writers.

These processes are not just features of writing pedagogy, however. The writing process as cognitively carried out by all writers is generally divided into these components.⁴ Individuals may perform different specific activities in their own planning, writing, and revising processes, but for all writers the cognitive processes involved in story creation fall into these three categories. They can be further characterized by processes within each larger process, which have been identified by researchers studying non-fiction writing. During planning, writers generate ideas, organize these ideas, and set goals for their writing. The writing process itself consists of translating these organized ideas into written language. Finally, revising involves reading and editing, two processes which detect and correct problems in the text (Hayes and Flower 1980, Flower and Hayes 1981). Even writers who are poor at planning and writing and do little revision do indeed appear to plan, write, and revise (Perl 1979). The underlying cognitive processes involved in most writing are what make the pedagogical division of the writing instruction into planning, writing, and revising a good and useful one.

These processes often are carried out in sequence, but they are processes that writers engage in at different time, not clear and distinct sequential stages (Daiute 1985a). Division of the entire writing process into three sequential phases is only a rough approximation which may be of use in educating young writers but is not an ideal representation.

⁴ The rapid writing method of Jack Kerouac, which involved no revision, and the automatic writing techniques of the Surrealists both seem to short-circuit this three-process model. The model of the general writing process described here may in fact be supported by such techniques, however. These writing methods are so radically subversive and dramatic because they go against the ordinary way in which we write.

PROCEDURAL FACILITATION AND COGNITIVE BENEFITS

Teachers and parents can assist children in writing stories in many ways. An adult can supply ideas, providing characters or plot outlines which the child can use in writing a story. Adults can also help with the mechanical process of writing by typing a story as children dictate. In evaluating stories, adults can provide guidance about what good story qualities children should build upon and can determine where they may need help in the future. The method of assistance this project focuses upon is not, however, related to the subject matter, to assistance in typing, or to evaluation of a story. The method used here involves help on abstract elements of the writing process, a structural form of assistance sometimes called *procedural facilitation* (Bereiter and Scardamalia 1982).

This category of assistance as discussed here has included many sorts of educational interventions. These range from oral prompts to mimeographed story planning checklists to computer writing environments with a wide array of interactive features. A procedure for revision, such as reading each sentence and thinking of an evaluative statement to follow each one (Bereiter and Scardamalia 1982), is procedural facilitation. The category also includes planning assistance to help with the development of story elements. The sorts of interventions not in this category include simply asking what happened next or suggesting particular subject matter.

Procedural facilitation can provide clear benefits that may be observed when the child is using the software or other prompting mechanism. Salomon distinguishes this as the cognitive effect *with* the software. This is related to how good of a helper or tool the software can be. Another effect is the lasting cognitive impression, or “cognitive residue” in Salomon’s language, made by a computer program. This is termed the cognitive effect *of* the software. This is related to the pedagogical value of the tool. An educational intervention that succeeds in having a lasting effect might serve to activate an existing skill that is suitable for writing. It also might help a student internalize some useful operation and add an additional skill to that child’s repertoire. Finally, it might help the child think more explicitly about the writing process, and then internalize this metacognitive ability (Salomon 1990).

These two effects — benefit during use and lasting benefit — are not exclusive of each other, but neither are they always complementary. A computer writing tool that helps a user write may lead to dependence on that tool, so that the writer actually becomes worse when deprived of that help. Or a tool may provide help that the writer internalizes as the cognitive process of writing is improved. Then, when that writer later sets out to write without the explicit help of that tool, its benefits will nevertheless be felt. One tool may provide its main benefit only after the writer has discontinued use of that tool. Another tool may be good for some specific task like proofreading but prove impossible for the writer to learn from. Of course, some tools provide neither sort of help, and some are designed well enough to be able to offer both sorts of cognitive benefit.

APPROPRIATENESS OF COMPUTERS IN ELEMENTARY WRITING EDUCATION

Although the innovations provided by a computer character have clear educational motivation and potential, some teachers question whether elementary school writers should use computers at all. Using a word processor for writing, as opposed to writing on paper, may or may not hold great benefits for students who are beginning to develop their writing abilities. A comparison of 32 studies, for instance, seems to indicate that while students who use word processors write better-quality compositions, they do not, as hoped, have better attitudes about writing (Bangert-Drowns 1993). Part of the problem is that in analyses like this one and often in discussion in general, the question considered is usually framed in terms such as “Do computers help children become better writers?” That question is so broad that it has no one answer.

Children’s cognitions are not affected by “Television” or “the Computer;” they are affected by specific kinds of *programs* with which they carry out specific kinds of *activities*, under specific kinds of external and internal *conditions* for specific kinds of *goals*. ... the question is not whether “the Computer” affects minds, but whether the combination of particular kinds of programs that entail particular qualities under specific conditions of activity, goal, and cognitive involvement can have (or can be designed to have) some lasting cognitive effects on children. (Salomon 1990)

A study in a Massachusetts elementary school determined that first-grade students who used word processors did significantly better, based on overall measures of writing quality and development, than their counterparts in the same class who hand-wrote stories (Keetley 1995). One study of more than 50 Italian fourth grade students, lasting several months, suggests that word processing can help to motivate students and result in more writing (D’Odorico and Zammuner 1993). At early grade levels it can often be easier for children to type than to write by hand, so longer stories can be written on the computer. Word processing in the elementary school is not always effective, but it can offer benefits in many situations, as the above studies show. While computers are not always an appropriate classroom technology for every educational goal — no technology is — software that uses the computer as a platform for writing clearly can succeed in bringing educational benefits to students.

The computer-based educational interventions explored here go beyond word processing, and are designed for children in grades 2-5. This group can particularly benefit from educational interventions to help them write in the absence of conversational prompts (Bereiter and Scardamalia 1982). By the second grade, proficiency with the mechanics of computer writing and use is high enough to make use of the system feasible. Much of the research on techniques to help children move from conversation to writing have focused on grades 3-6 (Bereiter and Scardamalia 1982, Hidi and Klaiman 1984), but children are ready for similar interventions by grade 2. In the recent past, facility with typing on the computer was often not acquired until later. This suggested that computer-based interventions to aid writing development should occur mainly in the second half of elementary school. Children are now beginning their computer use at earlier ages. Designing software for an age range a year younger is quite reasonable, given the increasing computer capabilities of young children, the resources of elementary schools, and the appropriateness of these educational interventions for grades 2-5.

CURRENT STORY-WRITING ASSISTANCE SOFTWARE

Education researchers at universities and commercial software developers have designed several pieces of writing software for elementary school students, some of which add interesting capabilities that assist writing in ways a word processor does not. The features of existing story writing software do not include a conversational computer character, but those innovative features that do exist should be examined and evaluated before creating any new program. Even software that is not innovative but is well-designed and usable can provide a model for the interface of a new system that incorporates more directed educational interventions. Finally, the failures and successes of current programs, as documented by empirical studies or observed in use, should inform any new effort to develop creative writing software.

Commercial Software

The most popular and best-selling writing software for children is, unsurprisingly, not the most innovative. The programs usually offer an augmented word processor that is designed to be easy for children to use. The editing and proofreading functions of the word processor are few, but added to it are tools for illustration. Such multimedia features make better selling points than most useful educational features would. However, some of these systems achieve their goal of being easy to use, fun to work with, and motivating, and thus have some measure of success.

The creativity suite Kid Works Deluxe by Davidson also combines a word processor with a paint program, for use by children ages 4-9. It typifies the commercial "first word processor" category, which adds multimedia capabilities like speech and drawing to a simplified word processor. The menus have graphical depictions of creatures instead of words like "File," "Edit," and "Format." These ambiguous symbols are more confusing than the words that are normally used, and of dubious benefit to children. The children who use the software have, after all, come to the program in order to write and do have the ability to read. The program does have some features well-suited to children. Children can create rebuses and switch the figures back and forth from words to pictures, learning spellings they might be unsure of. The text-to-speech system allows children to enter separate phonetic spellings of words by way of a speech editor, an option on the Cricket menu. This way, unusual words can be both written and pronounced correctly. Finally, there are "story starters," templates to help children begin writing that are common features in children's word processing software. Only one of the story starters supplied actually is designed to help start story writing, the others being templates for poetry, certificates, letters, and other forms of writing. This prompt suggests that the writer tell about the strange picture the artist is drawing. The pictured canvas is left blank so the child can draw in it (Davidson 1995).

The Amazing Writing Machine by Brøderbund is a similar suite. This program offers specialized sets of writing tools for creating stories, letters, journals, essays, and poems. Children can further pick one of nine writing environments genres within which to write, each corresponding to a genre such as fantasy, horror, and romance. Creative writing assistance is provided with Bright Ideas, a feature like Kid Works Deluxe's story starters.

Using this, students can customize a set of existing stories. They can choose words from a list or type in their own words (Brøderbund 1994). This allows them to create their own story before they are ready to do all the writing from start to finish. This program is well-designed and has won accolades and positive evaluations from several publications (ASCD 1997).

A more innovative approach to writing for a slightly younger age group (grades K-4), also by Brøderbund, is Orly's Draw-a-Story. This product is similarly a suite of writing and drawing tools, with four main stories that can be modified by children. However, in Orly's Draw-a-Story the Jamaican girl Orly serves as a central character with whom the user can interact in simple ways. Instead of offering help with story elements, Orly talks about Jamaican culture. She and the characters in the stories and provide story ideas and encouragement, though not in textual conversation (Brøderbund 1997).

Storybook Weaver Deluxe is a story-building suite of writing and illustration tools (MECC 1994). Reportedly included in the 1994 version of the software are "several story starters

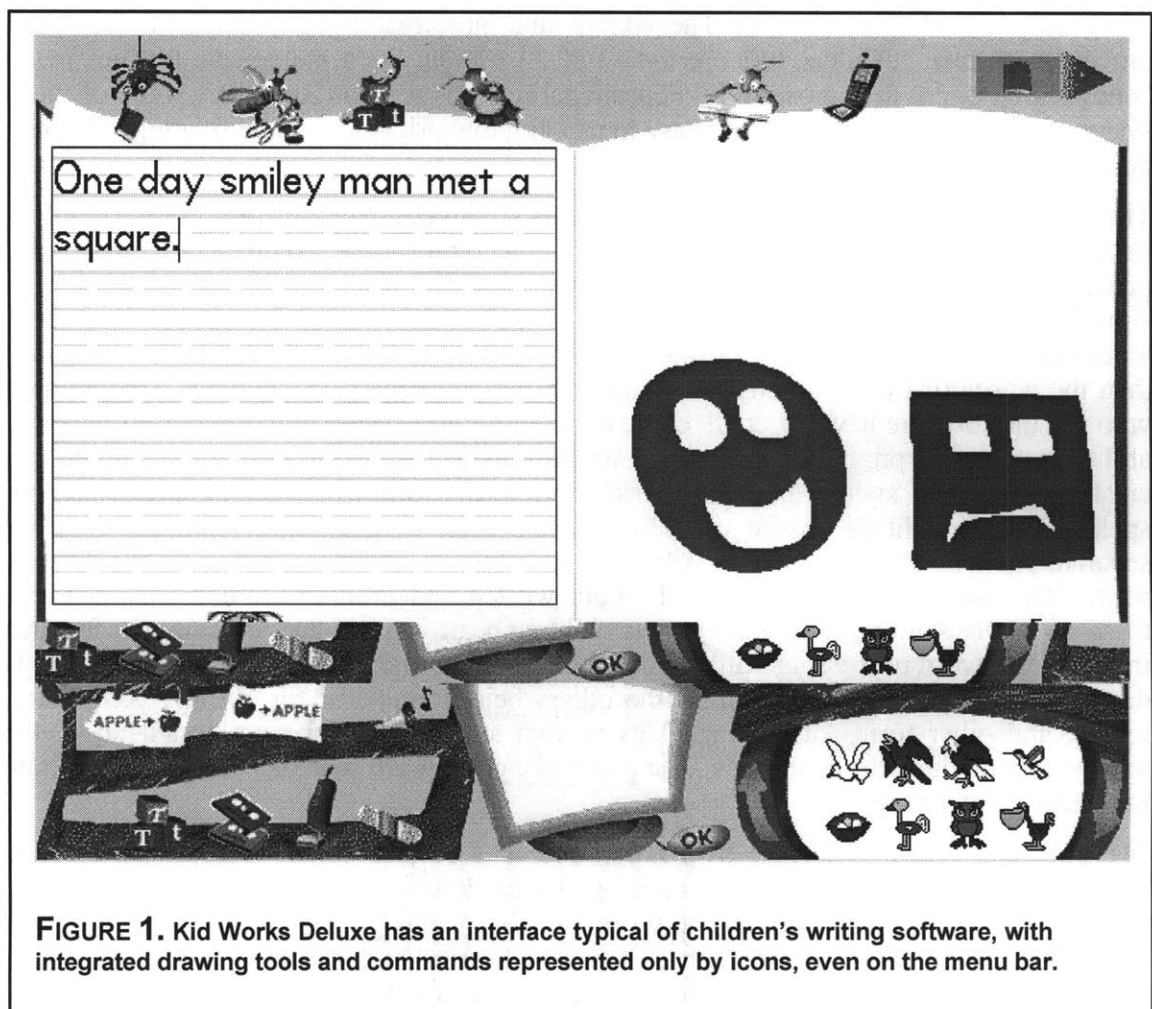


FIGURE 1. Kid Works Deluxe has an interface typical of children's writing software, with integrated drawing tools and commands represented only by icons, even on the menu bar.

that ask students who will be in the story, where the story will take place, when it will happen, what will happen first in the story and how will the story end” (ASCD 1997). Yet such a feature is absent in the currently available version 1.1 of the program, from 1994. The program does include several English and Spanish story templates that function like the subject matter suggestions in The Amazing Writing Machine, but ask no questions to help plan a story. The supplied story starter “Hey, that’s my face!” begins with an illustration of two identical girls placed on a shopping mall background. The opening line is provided below the image: “I couldn’t believe it. One day at the shopping mall I met a girl who looked exactly like me.” Storybook Weaver Deluxe has been highly ranked by several educational publications, earning five stars and straight A’s from *MultiMedia Schools* (Hixson 1996).

Another piece of software to encourage story writing is Once Upon a Time, which allows children to draw a picture and then write a story about it (Compu-Teach 1990). This software comes in three volumes, each with a different theme. Since this program is older, it is not as widely available as the products above. However, it has been used in one study that sought to compare the empirical benefits of a graphical story assistance program to those of text-based software. Learning disabled students used Once Upon a Time for part of the study and used a computerized list of story writing prompts during other times. The study concluded that such approaches may help address particular student needs if tailored to the individual student. This study was small and lacked a control group that used no special writing assistance software. It was not clear that either program resulted in substantial benefits (Bahr, Nelson, and Van Meter 1996).

Software Developed by Education Researchers

Many researchers have devoted extensive effort in developing software to aid in writing. Although few writing assistance programs have been developed specifically to offer help to young story writers, many interesting general-purpose writing systems for older students have been designed. Certain other programs employ techniques applicable to the writing process at all grade levels.

Burns developed programs for the US Air Force to aid college writers in planning essays. Although these programs were for a very different age group and type of writing, they address the user directly and interact in a conversational manner (Burns and Culp 1980). These programs date back to 1978 and influenced many other developers of prompting and planning software to assist writers. They were initially created on the VAX 11/780 and ported to some personal computers. Burns based the content of his three programs on different heuristic strategies in rhetoric. The concept grew out of earlier work in computer-assisted prewriting done by Ellen Nold at Stanford University in the early 1970s. Nold’s pioneering work, which asked students questions to help them identify a subject, audience, and organization for their essays, was influential to many early developers of prompting software (Wresch 1984).

The most widely discussed of Burns’s systems is TOPOI.

In this program, Aristotle’s twenty-eight enthymeme topics for generating a persuasive thesis (see his *Rhetoric*) are reformulated into thirty-seven questions or thought prompts

which challenge the student's understanding of his intended thesis in terms of definition, causes and effects, opposites and associations, consequences, and matters of fact and opinion. If the student's initial topic was "computers in education," for example, the computer would prompt, "What is the definition of 'computers in education'?" Or, "Who supports 'computers in education'?" The student's responses produce one of two results: a gradually expanding base of explicitly expressed relationships and perceptions, or a gathering realization that he does not have the information or insight to proceed with his thesis as formulated. The former result provides a transcribed self-interrogation from which a tightly developed thesis may be drawn. The latter informs the student early on that he needs to redirect his attention or research. (Kemp 1987)

TOPOI and Burns's other programs make little attempt to computationally analyze or understand the student's responses. TOPOI does recognize the types of questions the students might be asking themselves by looking for words like "why" or "what." It also notices if the response has fewer than ten words. It attempts no comprehensive assessment of input, however, seeking instead to help improve the students' assessment of their own thinking. In the context of then-popular intelligent tutoring systems, which used artificial intelligence to evaluate students and tailor training toward student needs, this was somewhat unusual. Yet Burns's software proved very effective as brainstorming and planning aids. Although developed to aid college essay writers, these programs employ techniques applicable to elementary school story writers as well (Burns 1984).

Burns's software addressed the user by name and in an informal way. For example, after the user typed that the topic of the essay would be "PROTEST AGAINST MATERIALISM," the program replied "HEY, THAT'S NEAT, WALLY! WE'LL HAVE A GOOD TIME THINKING ABOUT PROTEST AGAINST MATERIALISM." The voice is upbeat but it had few other traits. There is no clear motivation explaining why the voice of the software is offering help or questioning the user. The voice does suggest a person behind it with, for instance, a profession. It does not suggest an age, gender, nation or locality of residence or origin, or other typical identifying traits that a character has. It is unclear whether the voice is that of a peer, or more like that of an instructor. The voice does not reveal any quirks or defects that the simulated speaker might have, the sorts of things that make a character believable. Although TOPOI has a voice, it does not create the impression of a character behind that voice.

Woodruff, Bereiter, and Scardamalia developed computer prompts similar to those created by Burns but for younger children. Like TOPOI, their program provides sets of fixed prompts to help in planning, and does not analyze the text. It offers suggestions if the child does not type for 20 seconds, encouraging the writer to type anything that comes to mind instead of pausing. The program also provides a help menu with information about the structure of essays. A study found that children liked the program and said they found writing easier with it. However, the papers written with the program were not rated any better, and were not any longer, than those composed traditionally (Woodruff, Bereiter, and Scardamalia 1981-1982).

Daiute developed a program at Harvard University called Catch. This software was developed for use by young users, including those in elementary school. Catch extends the spelling, style, and grammar checking concept to providing more writing help. Users can select an option to get comments or questions about what they have written. Some prompts

ask things such as “Does this paragraph include details that help the reader see, hear, feel, or smell what you’re talking about?” Others suggest that phrases such as “sort of” and “well” might be unnecessary (Daiute 1985a). Children used the program to compose stories in one study, and some revised more after using Catch. The study, which examined how children used Catch and which features they preferred, did not determine whether using Catch resulted in any improvement in children’s writing quality (Daiute 1985b). Another four-year study of junior high school students showed that Catch users did improve their revising strategies significantly more than those who did not use the software (Daiute and Kruidenier 1985). Catch exemplifies analytic revising software, a program that examines the text that has been written and offers suggestions based on its algorithmic analysis.

Zellermayer and other researchers developed and tested The Writing Partner, an essay writing prompting program. This software was based on the theory of Bereiter and Scardamalia offered metacognitive prompts in an anonymous voice, such as “Is the reader a novice? Remember that he or she may need some basic facts about the topic.” These prompts appeared during the writing phase as well as during planning and revising. Two versions of the system were employed in a study, one providing help without a request from the student and the other offering help only when such assistance was solicited. The found that the unsolicited help software improved students’ writing both during and after the study. The improvement was significantly more than that of the control group and the group using the solicited help system (Zellermayer 1991).

A system called Write Environment was developed by Houlette out of experience with his earlier system, The Writer’s Plan. This system for older writers seeks to aid the process of writing by providing add-ons to Microsoft Word for Windows. For each type of writing behavior identified by Flower and Hayes (1981), Write Environment allows the writer to summon a window and get assistance. For instance, the writer can open a planning window at the beginning of the writing process, choose a method of planning, and write ideas in response to the selected style of prompts (Houlette 1991). Write Environment does not simulate conversation as TOPOI did. Instead, it simply lists its prompts all together in paragraph form and asks for a reply. It does, however, offer prompts and help for numerous activities that support writing, not just planning. In the current version of the software, there are windows for defining the central idea, organizing thoughts, thinking about the audience, and doing revision (Houlette 1998).

Another system geared toward supporting the different types of writing processes is MAESTRO, by Rowley and Crevoisier of the USAF Armstrong Laboratory. It is based on R-WISE, software to aid the writing process that was tested in 14 high schools over four years (1992-1996). Students who used R-WISE “outperformed control-group students on overall measures of writing quality and analytical reasoning skills, showing performance improvement of between one and two letter-grades.” Some instructional components of MAESTRO are compulsory, and students must demonstrate mastery of these before they are allowed to begin writing. Once in the writing workspace, advice statements appear based on the “emergent writing process of the student.” One such advice statement explains how to highlight text, but tabs for planning and revising offer higher-level help. MAESTRO is now being tested in middle schools as well as high schools (Rowley and Crevoisier 1997).

Rosebud is one of the only programs for very young writers that uses such a conversational exchange to encourage story writing, with requests for more if the story is brief. This system was developed by Glos at the MIT Media Laboratory in the Gesture and Narrative Language research group. The main point of the system was linking treasured toys to the stories told about those toys, and providing a way for children to record and exchange those stories. Rosebud simulates conversation with a simple request for a story about the toy presented, and a few additional requests after the story has been written. The software by Glos, like that by Burns, addresses the user by name in an informal way. Rosebud's voice also does not give the impression of a character with a motivation or identifying traits such as a profession, age, or gender. As Glos wrote of the program she designed, "I want Rosebud to have a personality, with likes and dislikes and quirks, but that only comes through weakly" (Glos 1997).

An earlier piece of software that had a conversational exchange with children was Sage, by Bers. Sage, also developed in the MIT Media Laboratory's Gesture and Narrative Language research group, is not a program to aid in creative story writing. Yet it does ask children to discuss problems or type short stories of personal experience. It also places the child in a definite framework of interaction, in the role of someone going to ask for advice from a respected religious or cultural figure. The conversation in Sage is with a character – in one case, a bunny assistant to a rabbi – who is human-like. The rabbit character, created by Bers, does have a motivation: to help users deal with problems through cultural lessons in the form of stories, as consistent with its religious beliefs and job. This character also has traits: it likes carrots and hopes that after helping the user, it would be rewarded with one. Children enjoyed interacting with Sage. The main goal of the project was to enable children to build their own characters. Because of this, there has been no study of how important to interaction the well-developed adult-created characters were (Bers 1997).

Limitations of Current Software

Interactive technology has indeed been brought to bear on children's story writing. But most commercial software simply adds multimedia elements and story starters to make a usable but limited sort of extended word processor. Of the conversational programs that do exist, no story writing programs focus the writer on a particular imagined audience. The absence of such a focusing character may not bother college writers, but for elementary school students who have trouble with the distanced nature of writing such an omission is a missed opportunity. None of the existing conversational programs put the writer in a strong dramatic situation which suggests a certain role and particular type of response. Again, while experienced computer users may be able to make use of conversational prompts without such a framework, motivating and scripting the user's action is helpful in general and particularly important for young users. The limited forms of conversation employed by current programs involve moving from one item to the next in a small set of responses. They often do not even provide any opportunity for user initiative in determining the order of questions.

Existing software can prompt writers to think about important issues related to story, encourage them to write more, and ask them to revise. Yet the available software does not

aid in the transition from conversation to solitary writing by offering intermediate forms of conversational support or an example audience. There is a clear need to provide a fuller framework for conversation, and build on progress made in earlier research. The development of new software can clearly extend the ideas implemented and tested in earlier work, particularly that done in the Gesture and Narrative Language research group. Character-based improvements can provide better interventions to improve children's story writing. The combination of effective existing techniques and a simulated conversational character constitutes a new approach not seen in previous computer writing assistance software.

INITIAL SOFTWARE DEVELOPMENT

FIRST CONSIDERATIONS

This project initially required development of three pieces of software: EddieEdit, StoryStages, and E-Write. EddieEdit is the writing assistance program with a conversational character interface. StoryStages is a program with similar information about story writing but no character or conversational abilities. E-Write is a simple word processor. These programs were for use in the study to evaluate how effective a conversational computer character actually was in helping students write stories. From the beginning, the plan was for development of EddieEdit and StoryStages to continue after the study so the software could be improved based on observation of and feedback from users. This section describes only the development that was done prior to the study.

Selecting a Platform and Programming Language

Most educational software sold and used now is dual format and runs on Windows systems as well as Macintoshes. Traditionally the Apple Macintosh, and before that the Apple II, have been the computers of choice for schools and young users. Now, more and more children have Windows-based computers at home. Apple computers still dominate in the elementary classroom and in school computer labs for grades K-5, however. Developing software that runs on both types of systems would be optimal.

The need for close integration with a standard word processor, however, means that the same program could not be simply generated in an integrated development environment and easily ported between the two platforms. A text editor like the Windows Notepad differs from SimpleText on the Macintosh. A program that functions like one of these could be created in a cross-platform development environment, but users on one system would be provided with a nonstandard writing tool. In addition to this concern, integrated development environments that enable the creation of applications for both Macintosh and Windows systems generally require additional development time and effort. The development process would have been unduly lengthened if each of the three programs was created for two platforms.

Another option which would allow cross-platform use and expand the availability of the system is the creation of a Web-based application. In fact the planning interaction with Eddie was implemented on the Web after the completion of the study, and Eddie has been made available online for conversational encounters. For purposes of the study, though, the desirability of close integration with a word processor is again a concern, and suggests a stand-alone application is preferable. Also, many elementary schools lack or restrict

Internet access. A Web version of Eddie might be a good way to demonstrate the system to educators and researchers. It would not serve writers as effectively as an application which integrated Eddie with a text editor.

Considering the academic nature of the project and the fact that it had to be developed by the author alone, creating a well-made program for one platform seemed, overall, to be the best option. The choice of a Macintosh platform was clear given the main role of the software as an educational intervention appropriate for school use. Since elementary schools that do have computing facilities often have older computers, support for older Macintosh operating systems and less powerful processors is highly desirable. So three systems created for use in the study were developed for 68000 series and PowerPC Macintoshes with System 7.5 or above.

Eddie himself is a character who responds to text input with text replies, having as both input and output lists of words. For implementing the conversational component, a text processing language like Perl or a list processing language like Lisp would be a natural choice. In fact Perl was used for the Web implementation of Eddie. However, Eddie also must be part of an application that is used in the study. The primary purpose of EddieEdit and StoryStages is to provide a usable writing environment for children. Perl and Lisp are both interpreted languages that are not optimal for fast performance. Although the software being developed is not highly complex, it may need to run on very old and slow computers, which have only limited memory available. A compiled language like C could provide better performance on low-end systems. To allow for close integration with a text processor and fast functioning, Macintosh C was selected as the programming language. This made implementation of Eddie's language processing capabilities difficult but ensured that EddieEdit and StoryStages could be made to work well as application software. The programs were developed in Metrowerks CodeWarrior 11.

Applying General Principles

In designing software, it is always good to be guided by design principles and to be focused on the user's needs and the way the software will likely be used. It is also useful to evaluate how general principles apply to the specific case of the software being developed, and when special cases call for designs that do not strictly conform to generic design ideals. Whatever principles, metaphors, and guidelines may suggest, the focus of design should be on the user and on the action the user is trying to accomplish by using the software. The computer should aid the story-writing process in whatever way is best for the process, not in those ways that conform to existing tools. Design of software should be guided first by the design of action, not the design of tools (Laurel 1993).

The decision to use different modes is an example of how this idea was applied in development. Apple's Macintosh Human Interface Guidelines suggest that applications be modeless. That is, rather than having planning, writing, and revision modes with their own particular options and windows, a single tool with menu options to call up a planning window or revision window would be preferable. Yet this may not be an appropriate approach. One early children's word processor, Bank Street Writer, had different modes for writing and editing to focus writers on the current task. The modes in this program

existed only partly for pedagogical reasons. In part, it was the memory limitations of the computer that made them desirable (Nicol 1990). This is not a concern in the current development situation, but the nature of the task is important. Modes are deemed acceptable by Apple if “they emulate a familiar real-life situation that is itself modal.” (Apple 1993) In the case of story writing, distinct processes have been clearly identified: planning, writing, and revising. These processes do not occur only in strict sequence, but they are separate cognitive processes — different modes of thought — used by writers. The modal nature of the story writing process therefore suggests a modal application.

Guiding Metaphors

As described by Solomon, there are two particularly prominent metaphors for computer’s role in educational computing. Advocates of the first hold that educational software at its best is an interactive textbook. The other camp sees the computer as an expressive medium with which children can learn. Not every software developer who embraces the same general metaphor has the same educational philosophy or takes the same approach. The former perspective, for instance, is manifested in the work of Suppes, a proponent and developer of software to aid in rote learning, and Davis, who favors Socratic and discovery learning methods. The later view is held by Papert, whose philosophy of constructionist learning draws on Piaget’s constructivist work. Another strong believer in the computer as a vehicle for expression is Dwyer, who has sought to emphasize using the computer as a tool in the problem-solving process. (Solomon 1986).

As Laurel advises, the developer who sees educational software from either of these perspectives should first consider the educational activity. So it is best not to characterize these viewpoints as *the computer as interactive textbook* and *the computer as expressive medium*. Instead, identifying the relevant activities that software is helping to accomplish is most enlightening. For those who hold with Suppes, these activities include drilling and practicing. The others mentioned above are more concerned with expression, discovery, and creation.

EddieEdit’s specifications and goals fit in with the metaphor of an interactive textbook to some extent, since its textbook-like base of story writing tips is the main feature. However, the program also provides a creative workspace in which students write, using the computer to express themselves without being forced by the software to write about a particular subject. So some elements from both constructionist software and more textbook-like approaches inform the design of EddieEdit, and both perspectives were kept in mind during development.

EddieEdit is neither a computer text nor simply a medium or tool for expression. A slightly different metaphor is best for characterizing EddieEdit — that of the computer companion

and helper.⁵ The closest analogy may be with those programs known as intelligent tutoring systems. These computer assisted instruction programs employ artificial intelligence, and used a related metaphor, the metaphor of the computer as instructor, as their guide. The intelligent tutoring systems category is not frequently invoked now in discussions of elementary school educational software, being more often employed in reference to training systems or other programs for adult education. For the most part those who call their programs intelligent tutoring systems have a drill and practice view of the computer's role in education. Most intelligent tutoring systems, for instance, used artificial intelligence to generate practice questions rather than simply retrieving them from a list, but the emphasis was on rote learning and not creativity. Such systems also often employed an expert system approach to attempt to deliver more advanced types of training, and the results did not always live up to expectations (Steinberg 1991).

There are essentially two differences between EddieEdit and the typical intelligent tutoring system: EddieEdit is not intelligent, and not a tutor. EddieEdit emphasizes conversational ability and not the building of internal knowledge representations. The software exists to help users plan stories, not to itself engage in planning. Also, EddieEdit does not have any facts or low-level skills that it is trying to teach the user. Instead, the program seeks to stimulate students and help them think more about the writing process. Rather than teaching writers what story elements are and quizzing them about these elements, EddieEdit encourages them to explore story elements by employing them in their stories.

EddieEdit differs from an intelligent tutoring system substantially, but a few of the principles employed in developing these sorts of systems do apply to EddieEdit's development. For instance, the restriction of computer "expertise" to a small topic area is essential to the success of any intelligent tutoring system, and also applies to creating a non-intelligent conversational system which can converse well within a narrow domain.

Applicable Constructionist Principles

EddieEdit has textbook-like and Socratic elements, and is not a system in which children learn by programming or creating systems that do things within the computer. Seymour Papert describes the outlook of constructionism by writing that in contrast to the traditional view in which the computer trains or programs the child, "In my vision, the child programs the computer" (Papert 1980). EddieEdit is clearly not such a system, not a programming environment like Papert's LOGO.

EddieEdit does have a creative process at its core. It is a system to help children create stories. It does not provide drill problems for them to solve, but offers to help them in writing a story on a topic of their choosing, with characters, events, and locations of their

⁵ Calling Eddie an "agent" is avoided here and elsewhere in this paper. The term has been very broadly applied in recent years, to refer to either human-like characters or programs with no human features, for instance. At the time of this writing the term is rather denuded of meaning. It does often suggest a computer helper that manipulates outside data on behalf of a user, searching the network for information, for instance. Eddie does not do this. A better distinguishing feature of Eddie is his conversational ability and status as a character.

choosing. Students are not required to converse with Eddie before they begin writing, or required to revise. All the educational interventions in EddieEdit are intended to support a child-directed creative process. The planning conversation with Eddie is to enable children to frame their ideas so they can use the program's story-writing space to play with these ideas. While the system is developed out of particular developmental concerns in story writing and embodies approaches from different philosophies of education, there is certainly much to be learned from the development of constructionist educational software. EddieEdit, like a constructionist programming environment, is built considering the child as a creator who uses the computer as a medium for expression.

EddieEdit was designed keeping in mind the principles used by Amy Bruckman in creating the constructionist environment MOOSE Crossing. Creating this online world involved developing a text virtual world programming language for children of about the same age group as EddieEdit's users. In creating this language, Bruckman outlined several design principles to keep in mind when developing a programming environment for children. Although Bruckman designed a programming language and not a story-writing application, some principles are also particularly meaningful for designers of educational application interfaces. Of her eight principles, those most relevant for EddieEdit are:

- Prefer intuitive simplicity over formal elegance.
- Be forgiving.
- It's OK to have limited functionality. (Bruckman 1997)

Formal elegance in implementing an interpreter, for instance, is analogous to strict adherence to all user interface conventions in application design. In both cases, developing for ease of use and accessibly to young children is more important than creating a system that will impress programming experts.

Compulsory and Voluntary Assistance

It was decided very early in the design process that neither EddieEdit nor StoryStages would compel users to receive writing help. Writers would begin in planning mode but could skip to writing immediately without responding to Eddie or typing anything beneath the StoryStages prompts. Revision would not be compulsory either.

This decision was grounded in a philosophy of software design, not based on specific results from educational research. In fact, one study has indicated that compulsory writing assistance systems result in greater educational benefits than ones in which the user can choose not to use the assistance features (Zellermayer 1991).

A program that offers mandatory writing help is different than a drill-and-practice program which quizzes the user. A quiz program exists only to train and quiz. A compulsory program uses its mandatory training and quizzing features to prevent the user from accessing the chief function of the program (in this case word processing) independently. By dangling the carrot of a creative environment but not permitting access to this environment until the mandatory training is finished, a program can frustrate and discourage able writers. Even those who could clearly benefit from the assistance should

not be held back if they are eager to move on the writing and have an idea they wish to begin typing up immediately.

In the world of consumer software for the general population, compulsory assistance programs are not tolerated. If the current version of Microsoft Word were one of these compulsory programs, for example, the little paper clip character called the Office Assistant could never be made to go away. Microsoft Bob's failure demonstrates that such systems are not desired by those who can choose their own software. It is inappropriate to inflict such a system on a classroom user who cannot make such a choice.

A compulsory program may help young writers in ways that have been quantified, but such software can also do harm that has not been or cannot be quantified. They discourage users from thinking of the computer as liberating and helpful, instead offering them an electronic dictator who demands capitulation. Such software reverses the proper relationship between user and computer, putting the computer in charge. Software like this is popular in education and serves to effectively address some narrow goals, but the analysis of numerous experts in software development should persuade developers to move away from this approach. Software that compels the user to serve its own goals is opposed by principles of Constructionism (Papert 1980) and Feminist Software Design (Cassell 1998), for instance.

CREATING E-WRITE, THE WORD PROCESSOR

The program used as a baseline, and as the word processing basis for the other two writing programs, is a simple text editor. In determining what particular features it should have and which it should omit, careful consideration of the target user group was the guiding factor. This means that the program had to use commands familiar to young Macintosh users and have good fundamental text editing capabilities. It was almost essential that any pre-existing program employed as the comparison word processor have its source code available. This would allow the other software to be built on top of the original word processor, allowing StoryStages and EddieEdit to closely imitate portions of the original software's feature set and interface.

A spelling checker was not necessary. A feature like this could take the focus away from higher-level thinking about story writing by emphasizing the details of orthography. Spelling checkers also can be detrimental to elementary school writers because they report proper nouns as misspelled and do not catch many errors. Many of the misspellings made by students of all ability levels are actually homonyms or other dictionary words and are not detected by spelling checkers (MacArthur 1996).

The program used was a slightly modified version of Apple's SimpleText 1.4, named Elemental Write and abbreviated E-Write. The SimpleText source code has been made publicly available by Apple. SimpleText is straightforward and usable, and, as one would expect of standard Macintosh software, it follows good principles of interface design. However, even this simple program has some features which are unnecessary for story writing. The removal of these extraneous features streamlines the software and enhances

the ability of users to focus on the main task, writing stories. The word processing features of StoryStages and EddieEdit are identical to those of E-Write.

SimpleText has the ability to read typed text back to the user in a variety of synthesized voices, using whichever standard Apple text-to-speech synthesis extension is installed. Text-to-speech features in general are very useful for such applications as providing access to children and adults who are visually impaired. However, for words not within the text-to-speech dictionary, lexical stress within words is determined algorithmically. This does not always result in correct pronunciation. Also, grammatical complexity makes it hard to computationally determine a word's part of speech. This means it is difficult to determine how a word should be pronounced when its pronunciation depends upon what part of speech it is. Although the speech may still be understandable despite mispronunciations, text-to-speech could backfire in an educational context and teach children improper pronunciation. Additionally, the feature does not seem important for elementary school story-writing, and could simply distract writers from their main purpose. So the speech menu and its features were removed.

The ability to change fonts using the Font menu was also removed. In part this does stem from a concern that children will macdink⁶ rather than write stories, a compulsion to which adults are also subject. Yet the removal of font control does not just disable a feature that children may misuse. It is not simply "watering down" an adult word processing feature, a technique in children's software development too frequently used in place of real consideration of the user's needs and the task's nature (Druin 1996). Some focused writing software for adults, such as the Macintosh program NewsEdit (designed for reporters who will never be doing page layout), also lacks font control. The main concern in E-Write, as in NewsEdit, is the writing task, not the appearance of the type. Although font control was disabled, children might reasonably want to resize text in order to read it more easily, and may reasonably wish to apply styles to the title or other parts of the story. So the Size and Style menus were left as part of E-Write.

The perception of software as new or unfamiliar may itself have a positive or negative effect on writing, regardless of the quality of the software, and regardless of the software's actual novelty. The name of this program was changed so the software would not proclaim its heritage as the standard Apple text processor, in contrast to the two new programs.

THE PLANNING AND REVISION PROMPT LIST

Eddie Edit and StoryStages share a set of prompts to help young students write stories. In StoryStages this is embodied in an ordered list of questions that are intended to children plan and revise stories. In EddieEdit, these same prompts are integrated into conversation and changed slightly so as to be in Eddie's voice. However, the versions of StoryStages and EddieEdit used in the study do not differ in terms of how much information about story planning and revising they display.

⁶ "To make many incremental and unnecessary changes to a program or file. Often the subject of the macdinking would be better off without them. 'When I left at 11 P.M. last night, he was still macdinking the slides for his presentation.'" (The Jargon File 1996)

In selecting what planning and revision techniques it is appropriate use with children in grades 2-5, it is important to consider how language abilities in general develop in children. Before children can accomplish certain things alone, they can do those things with help. The zone of proximal development is that area in which the child can accomplish cognitive tasks (including linguistic ones) with the help of older children or adults, and learn from this experience to accomplish them alone (Vygotsky 1978). By designing interventions in the zone of proximal development, and avoiding activities that are too difficult to manage with help or that can be done unassisted, education can foster the development of linguistic abilities. Adults offering assistance to children in telling oral stories employ strategies which operate in the zone of proximal development to effectively help children improve (Pellegrini and Galda 1990). For both planning and revision, computer techniques should challenge children to improve their writing process but not be overwhelmingly difficult.

Planning Prompts

The planning prompts suggest that children describe most of the story elements they are going to use in writing. To write the questions on the planning list, the author considered planning prompts already fruitfully used in the elementary classroom. The ones examined were described in Bahr, Nelson, and Van Meter (1996) and Graves and Hauge (1993). The ordering of the list in the StoryStages system and the high-level categories and most basic questions were taken from the story grammar prompts described in these systems. Bahr, Nelson, and Van Meter included questions about the motivation and feelings of characters, very important aspects of the story which are often not considered in a basic story planning checklist. These two questions were included in the planning prompts for StoryStages and EddieEdit. Additional suggestions for how character development might be encouraged through simple prompts came from Leavell and Ioannides (1993).

The list of prompts was expanded and refined with traditional story elements in mind. The development of questions was particularly informed by story elements as described in Aristotle's *Poetics* (1968), the basis for much of Western thought about the story. The questions relating to character were particularly informed by the types of characters discussed in E.M. Forster's *Aspects of The Novel* (1927). The prompts associated with plot are influenced mainly by thinking of Gustav Freytag. His description of rising action, complication, and denouement are well-known and foundational in the study of drama (Freytag 1894). Freytag's concepts apply to early story writing as well. Special consideration was also given to balancing external features of the story, including plot and setting, with internal ones, such as the thoughts and feelings of characters.

General prompts that simply ask for more story events (for example, "Then what happened?") have been used in story-eliciting software (Glos 1997). These are effective around age 5, when children retelling stories orally need help organizing and completing the telling of a sequence of events that they know. Children at that age are ready to improve their ability to connect events together, and this sort of prompting helps them move through the zone of proximal development. By varying the nature of these prompts, teachers can encourage growth and help children better their storytelling (McNamee 1979). But by the time children are writing stories this sort of development has, in most cases, been

accomplished. Older children can retell stories and connect events, and are then in a different developmental zone. During grades 2-5, questions about elements of the story are more appropriate.

The planning prompts, as they appeared in the version of StoryStages used in the study, are:

1. What are some things you would like to write a story about? List a few things that come to mind.
2. Now, look at the list above and pick some ideas. Decide what your story is going to be about. It can be about more than one thing.
3. If you like, give your story a working title. You can change the title later if you want to.
4. Who is going to be the main person in the story - the main character?
5. If there are going to be other characters, who are they?
6. Where will the story happen?
7. What does this place look like?
8. When will the story take place?
9. What will be happening at the beginning of the story?
10. What will happen to the characters during the story, or what problem will come up for the characters to deal with?
11. What are they going to do? How will they act when that happens, or how will they solve the problem?
12. Why will the characters do that?
13. When the main event in the story happens, how do the characters feel?
14. How will the story end?
15. How do the characters feel at the end of the story?

In the interest of not overwhelming the writing task with planning that is excessive or too complex, many important distinctions and a more in-depth treatment of certain elements have been omitted. For instance, the prompt “What are some things you would like to write a story about?” could be asking either about the subject of the story (a boy buys a baseball card with a forged signature) or the theme (the nature of appearance and reality). This distinction between subject and theme is usually explored first in reading, often later in a student’s K-12 education. Emphasis on some points that are not yet well understood in grades 2-5 could inhibit rather than facilitate story writing. Similarly, there are no prompts to suggest that a story can have a particular mood or atmosphere distinct from its setting in time or space. No prompts suggest that one could write the same story in different voices and styles or implore the writer to think about voice. However, the prompts should provide a good starting point for exploration of story elements by students in second through fifth grades, suggesting that they think of plot, character, and setting. Even more complex ideas

are suggested by some of the prompts that ask the writers to think about what their characters feel. These prompts could help young writer begin to understand that characters can be static or dynamic, can be round or flat, and should have motivations for their actions.

Like any form of writing instruction, these prompts tend to encourage certain types of stories and discourage other types. These prompts might dissuade students from writing stories in the form of folktales and parables, in which the time and place may not be very well-specified and the characters are neither particularly round or dynamic. Many interesting stories have been written in which little real action takes place. In many good stories, the main character does not solve a problem. This sort of writing, too, would be discouraged.

The emphasis placed on traditional story elements by these prompts is, however, a useful one at this grade level. These prompts do encourage students to think about new aspects of character and plot, and to have the experience of writing stories that explore these elements more fully. Children may have trouble answering all the questions, because, for instance, they plan for their characters to all die rather than solve the main problem. In this case their inability to answer all the questions could encourage them to begin thinking about new possibilities. The prompts would suggest to such a writer that it is possible to write stories that have a complication and resolution, rather than just annihilation. The particular stories that children wish to write later, when they are not using StoryStages or EddieEdit, may not emphasize all of the story elements equally. Many very good stories do not. At least by using these prompts, however, young writers will gain a wider range of writing experience and become more aware of the roles each element can play.

Revision Prompts

Neither EddieEdit nor StoryStages analyze the text to suggest changes based on what has been written. Instead, both programs have a list of revision prompts that are generic suggestions for how a writer can analyze a story by himself or herself. This decision about the functioning of the two programs was made for both practical and theoretical reasons. Programs that do not analyze the text of course provide less specific guidance regarding what needs to be revised. However, it may be easier for students to internalize the suggestions about revision that are offered as simple prompts.

Montague and Fonseca suggest that both prompting and analytic software can lead to independence in writing as students monitor their own writing using the computer as a tool (1993). In the category of analytic software, a non-educational but illustrative example is the grammar checker. The opaque analysis that a computer grammar or style checker does makes it a useful tool for proofreading. As the grammar checker makes suggestions, however, it is not clear to a young user how the computer is making its determination that a sentence is too long, or why it is suggesting the writer use “that” instead of “which.” Although programs like Daiute’s Catch and grammar checkers included in current versions of Microsoft Word explain their grammatical suggestions, the habit of using such a tool could have some negative effects for developing writers. Students who gain independence with the help of such software may simply be exchanging dependence on the teacher for

dependence on the difficult to understand processes of the computer. Simple prompts, on the other hand, can be easily learned and students can take their suggestions with them when they write in other contexts. The critical feature of successful systems like those by Burns is the ability to ask “the question which provokes,” not any sort of analytic prowess. “[T]hat the computer cannot evaluate student responses is in fact a strong argument for, not against, the software” since students have to formulate answers themselves and cannot rely on the software (Kemp 1987).

The general revision prompts come from those used in the elementary classroom and from those suggested by creative writing and expository writing teachers at other grade levels and in colleges and universities. Particular problems with coherence that are observed in young writer’s stories suggested that one prompt ask about how easy it is to understand what is going on. The heightened importance of the very beginning and end of a composition also suggested that revision prompts be directed at those parts of the story (Trimble 1975). Finally, in selecting prompts, simple suggestions that children could understand and internalize were preferred over advice that might be useful but would be difficult to internalize for later use.

The revision prompts in the initial version of StoryStages were:

1. A great beginning can make your reader want to read more. Do you think the first sentence is really great?
2. Can you write a better first sentence? Try it if you want to.
3. The best stories have a great ending that readers remember. Is your ending really great?
4. Can you write a better ending? Try it if you want to.
5. Telling about how your characters think and feel can make them seem real. Did you tell what the characters do and also how they feel?
6. Find somewhere where a character does something important. You can write a sentence about what the character is thinking, if you want to.
7. See if you want to add new sentences anywhere to make the story more clear. Is it easy to understand everything that happens?
8. If you thought of changes you want to make, be sure to go to the story window and type them in. How many changes did you make?

The hope is that these prompts will cue children to look back and remedy common mistakes. At least, they should be effective in communicating what the revision process is like, and introducing the concept of revision as an integral part of the whole writing process.

DEVELOPING STORYSTAGES, THE NON-CHARACTER PROMPTING SYSTEM

Creating StoryStages involved several types of development work. These included the creation of a checklist box, design of the overall forward flow of the writing phases, and

development of dialog boxes to support this flow. It was also necessary to integrate these and other minor components with SimpleText's word processing capabilities.

The main educational intervention in StoryStages is the prompting it offers during the planning and revision phases. This type of prompting has been implemented in many programs, described above, although never for children in this age group. The prompts are provided in StoryStages through the checklist box. The checklist box is a dialog box that contains a scrolling list of prompts. These prompts are displayed in static text — text that cannot be edited by the user. Below each prompt is a user-editable field where the writer can type a response during the planning and revising stages. Saving and restoring will store and retrieve the responses that have been written so far. During the writing phase, the responses to the prompts are visible, and the writer can scroll through these and review the story plan while writing. All of the text in the list is static in the writing phase, however.

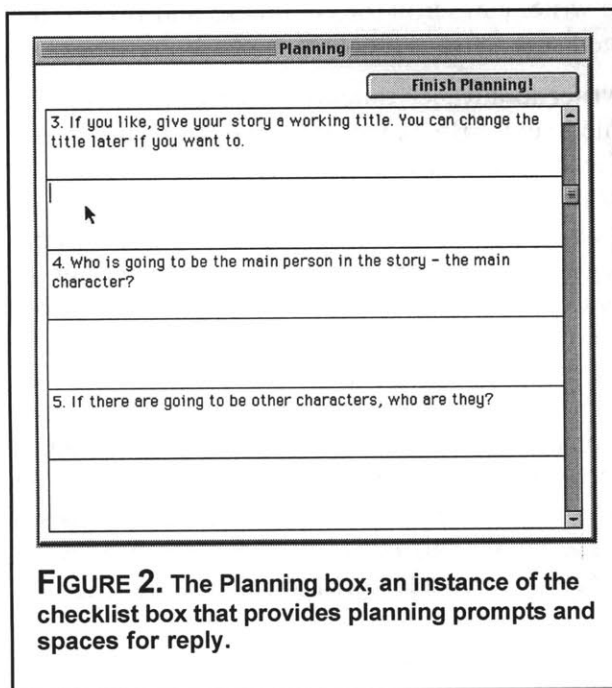
A button at the top of the box allows the writer to advance quickly to the next stage. The command is also available on from the File menu. By using this button or the menu command, the user can progress through the stages sequentially, but cannot backtrack. It was not possible, for instance, to return to planning once one had begun writing. This does not represent the actual way in which writers move between writing processes, since a plan may be reconsidered once writing has begun. At this grade level, it is important to emphasize and distinguish the different types of writing process. So it may be somewhat appropriate to sequence the stages rather than having different modes which one can enter and leave at will. For the most part, however, this sequencing was dictated by the nature of conversation and concerns about implementation, not by the nature of the writing process. It seemed substantially more difficult to implement a system in which users could terminate and re-start a conversation with Eddie, and conversationally revise their planning goals. In EddieEdit, at least, it was easier if users progressed sequentially. To make StoryStages a good comparison system, it too had to be sequential. This one-way progression between processes was identified as a feature that should receive additional attention during testing and further software development.

Care was taken to clearly indicate when the user is about to start a new phase and to confirm that this is desired. A dialog box appears when the user gives the command to move to the next phase, asking, "Are you sure you want to go to the next step? You won't be able to go back." Some sort of indication of what phase the user was in would be important even if the user could move freely back and forth between phases, since "for new users, entry into and exit from a mode should be very explicit" (Nicol 1990). In this case, it is essential to require confirmation for moving to the next phase because of the impossibility of backtracking.

The checklist box is limited in a few ways. Neither the prompts nor the response to prompts can be longer than 255 characters. This makes the system less versatile, as lengthier prompts for older writers cannot simply be plugged in. For second and third graders writers who will read multiple prompts before and after they write, 255-character prompts are more than adequate. Ideally the text they read should be no longer than a single line. A greater difficulty is that the computer prompt and the user response are displayed in the same text style. This avoids elevating one of them in importance, but makes it difficult

for the writer to see quickly what has been written in response to the prompts. Unfortunately, the dialog manager rather than window manager was used to run the checklist box, in order to allow development to proceed more rapidly. This made it impossible to add different styles to the different sections of the list. Without this compromise in usability it would have been extremely difficult to implement the important educational features of the program in the time available for development.

The initial activities required for use of StoryStages and the transitions through the phases are described in detail by dialog boxes that appear throughout a writer's interaction with the software. These boxes contain large amounts of text, probably more than one could reasonably expect second and third grade students to read. However, it is made available for those who do take the time to read it and for the adults who may come to help a child who is having difficulty. The dialog boxes offer explicit instructions in order to allow untrained users to move from never having seen the software to being accomplished users of it within a few sessions, without training or instruction from the developer.



At the beginning of the writing process, the writer is asked to either start a new story, open an existing story, or read the instructions. The help boxes that can be displayed at this time are available during all phases of the writing process. They describe the process of writing, explain that questions are offered in the planning and revision phases, and give instructions on how

to move to the next phase. If the writer opens a story, the program moves to the appropriate phase for that story immediately and writing activity can continue there. If the writer wishes to begin a new story, the program asks for a name and saves a blank file while moving into the planning phase.

The Planning box (one instance of the checklist box) appears when the writer begins the planning stage. This occurs just after starting a new story and upon opening a story still in the planning stage. All sections of text in the list become static when the writer moves to the writing phase, and the checklist window remains available. Upon entering the revision phase, the Planning box closes and the Revision box (another instance of the checklist window) opens. This Revision box is identical to the Planning box except that the prompts are revision prompts, and the button reads "Finish Revising!" When the writer finishes revision and moves to the end phase, this Revision box closes as well.

Students can move to the next phase without answering prompts or modifying the text typed in the word processor. Stories and answers to prompts are saved when the save command is invoked, and saved automatically when the writer moves to a new phase. The main word processing window is cascaded over the static Planning box, but neither window can be closed without exiting the program. To begin a new story, a writer must exit the program and start it again.

The planning and revision prompts are stored in a resource file with 20 strings allocated for each. On startup, the program reads through its resources and adds all of the planning and revision prompts to the appropriate list, up to the first empty string. This means the resource file could be edited by a teacher or school district so the program would use customized prompts. The process is not easy, but it does allow the prompting lists that the program uses to be modified without recompiling the program. Teachers can write any number of custom prompts for StoryStages, from 1 to 20, for use in planning, and can create a similar customized list of up to 20 prompts for revision.

CHARACTER DEVELOPMENT OF EDDIE

Eddie is a character, and his nature as a character is central to his purpose. Like any character, he should exhibit defining traits, have a motivation for his action, and be appropriate to the larger work in which he appears. For the program to be successful, the development of Eddie as a character must be kept very much in mind during the development of EddieEdit as software.

Creating a Computer Character

In developing conversational computer systems in general, no matter what age the user, it is important to place the user in a role of some sort. This role can be made clear by the computer character and the context of interaction. The developer “must script the interactor as well as the program, must establish a dramatic framework in which the human interactor knows what kind of things to say.” (Murray 1997). In interacting with Eliza, a system which simulates a psychoanalyst, the user knows it is reasonable to talk about feelings of depression or instances of emotional trauma. It is clearly unreasonable to ask Eliza out on a date or attempt to begin a theological debate. The dramatic or social context in which the user is interacting is clear. If a conversational program simply says, “Tell me a story” or “List some ideas for your essay,” the user has been given a task. The software provides no idea of what to do, however, only indicating that some entity that desires the story. “Tell me a story” could be the request of a virtual younger sibling, a teacher, a movie executive, or a psychoanalyst. This phrase alone does not give the user a clear role, and does not tell anything about the listener or audience. Whether the story is being told to amuse or to teach a lesson is important, but unknown. Whether the essay is supposed to inform or persuade is unknown. Why the computer voice even wants to help the writer or hear the story is also unknown. A final important cue that is lacking would suggest whether the audience for this story is a peer, a younger child, or an adult.

Extreme detail in the representation of a computer character is not necessary and may even be counterproductive. “[T]hanks to well-internalized dramatic convention, we can enjoy (and even believe in) even one-dimensional dramatic characters.” Elaborate characters, on the other hand, may raise the user’s expectations to levels that cannot be met (Laurel 1990). A computer character should still have clear motivation and a few defining traits, of course, but more can be left to the imagination than would be in the case of a literary or cinematic character. The work done in Carnegie Mellon University’s OZ Project suggests that a character should be believable. “This does not mean that the agent must be realistic. In fact, the best path to believability almost always involves careful, artistically inspired abstraction” (Loyall and Bates 1997).

Development of Eddie’s character was done with consideration of the above requirements. Also carefully considered were the general elements which make a believable character in forms of narrative such as writing, drama, film, and storytelling.

Analogies to and Differences from Peer Editing

A computer character who is a peer editor suggests analogies between the software and peer editing by children in the classroom. Although Eddie is an elementary school student and offers revision tips, EddieEdit’s development was not motivated by a desire to replace or emulate peer editing. As Eddie’s character is defined, it is important to make him like a peer in certain ways. As he is made to function in the software, it is important to distinguish his purpose from that of a real peer editor.

Eddie does not have the advantages of a real peer editor. EddieEdit does not appreciate stories, and certainly could not be made to do so in as genuine a way as another child would. Eddie also does not try to understand stories, or to offer the level of commentary on content or clarity that a peer editor would. Of course, peer editing is also a reciprocal process, and the children benefit from providing critiques as well as from receiving them. This helps the student acting as editor develop critiquing skills in a way EddieEdit is not designed to do.

A peer editor, however, also cannot do all of the things Eddie can. A peer editor at this grade level will not initially “know” as much as Eddie does about generally useful steps in story planning and revising. Another child will also not reply with sentences that are always grammatically correct, punctuated and capitalized properly, and spelled correctly. It is not essential that children read only such impeccable language. Reading improper spellings and poor grammar will not damage a child’s linguistic development, but EddieEdit can provide them with an good example of proper writing that can contribute a bit to improvements in writing. EddieEdit can be used at home or during times when peer editors are not available. Eddie is not real, unlike a peer editor, and so he may help children envision an absent audience. The conversations he has are written, not oral, providing a different sort of help in moving from spoken to written discourse. So Eddie, an imaginary character who has written conversations with children, offers a different educational intervention that may assist the transition from spoken conversation to writing in a way peer editing does not.

While Eddie is not supposed to be a facsimile of a peer editor, EddieEdit is compatible with peer editing and even collaborative writing. Children were asked to write alone during the study that was conducted, but this was done to make evaluation straightforward. EddieEdit could work with many educational approaches, and could be integrated into anything from focused subject-specific writing projects to independent activities at home.

Defining Eddie

The conversational computer character in EddieEdit is Eddie the Editor, a virtual fourth grader who is the fiction editor of the fictitious periodical *Elementary Magazine*. Eddie is an extremely precocious young child when it comes to story writing, but speaks as a peer of the writer. His grade level and age are not explicitly mentioned so students in all grades 2-5 might be able to identify with him. EddieEdit, like StoryStages, encourages the writer to share their work with their peers when they are done. Eddie is there during the writing process to serve as a more immediate audience for the child's story.

Eddie manifests himself simply in text. Some simple graphics could certainly be appropriate and help children identify with Eddie without distracting them from writing. The comparison systems lacked any graphics, however, and it would have been difficult to sort out the effect of even a simple icon from the other features of Eddie. Because Eddie is an all-text character, what he says must, of course, be very carefully considered.

Although a peer, Eddie's job as editor makes it reasonable that he would make suggestions to help structure the child's story and to offer tips on revision. He does not try to co-narrate with the user, however, respecting the user's role as story writer. Eddie does have some preferences. Rather than instructing the writer to write in a particular fashion, he will offer questions and suggestions, saying that these are the things he thinks about when he writes. Eddie tells his name and greets the user, then describes his job: "I'm the editor of my elementary school's magazine. I help people write stories." Eddie begins his discussion of story by telling about what helps him: "Before I write a story, I plan it. First, I think of all my ideas. What things do you want to write about?"

Eddie also has a few characteristics that are related to making him believable rather than being related directly to story writing. He's got papers on his desk that sometimes fall off, and occasionally another child may distract him, which explains why he can sometimes be forgetful or a bit inattentive. These occasions, which serve to cover up for Eddie's limited understanding, are also used to focus the conversation again on the task at hand. For instance, if Eddie can't understand whether or not the user likes stories, he responds: "Well — Hey, Billy does not know more dinosaur names than me! Sorry, someone else was talking to me. What were we talking about?" If Eddie failed to understand what was a clear answer, he appears easily distracted (a reasonable trait for a fourth grader) but not stupid. Eddie's distractibility thus also lowers the expectations of the user regarding the character's responsiveness, which makes it easier for the software to meet those expectations (Reilly 1995).

Eddie has a few characteristics that were included to make him believable, but he doesn't have hobbies, class projects, sports that he enjoys, or other interests. At least, he doesn't

talk about any of these things. Although including such attributes would make Eddie a more complete character, it might also make children too attentive to Eddie's particular interests. For instance, it might suggest to them that they write about whatever sport Eddie likes to play, even if they prefer a different sport. So, to keep the software neutral in terms of story topics, it was decided that Eddie would not discuss any of his own interests outside of writing. Also, if Eddie mentioned that he likes, for instance, playing Frisbee, this would suggest that the conversation could turn to discussion of Frisbee. Additional effort would be needed to expand Eddie's conversational abilities to allow such discussion. Since this discussion would distract from the story writing task, such effort would not be wisely spent.

Eddie uses a simple vocabulary and good grammar. Some of Eddie's speech is informal, although Eddie does not try to use "cool" grade-school slang. His particular non-story-related interests and hobbies are left unspecified. Although this makes Eddie a flatter character than he otherwise would be, it also assures there is no suggestion that the user's stories be about Eddie's interests and hobbies. Eddie's manner of conversation generally is consistent with an ordinary if somewhat bookish peer audience. He speaks the way an articulate grade-school character would in a children's book — hopefully a well-written children's book.

DEVELOPING EDDIEEDIT

EddieEdit is essentially a modified version of StoryStages which has a conversation box instead of a checklist box. Inside this box the writer types responses to Eddie's text. The response to the user's text is determined by the Eddie conversation engine. Development of EddieEdit consisted of creation a new conversation box that substituted for the checklist box, and creation of the conversation engine.

The conversation box is similar in size and appearance to the checklist box. Initially, only a greeting from Eddie appears in the section next to the bottom. The bottom section can be typed in by the writer. If the writer types a reply and presses return, the conversation engine is given the reply and Eddie's response is generated. The writer's talk, and then Eddie's reply, are added to the bottom of the non-editable list, which scrolls upwards and grows as the conversation continues. After Eddie has said all he can about story planning or revision, he concludes the conversation and the conversation engine ceases to generate

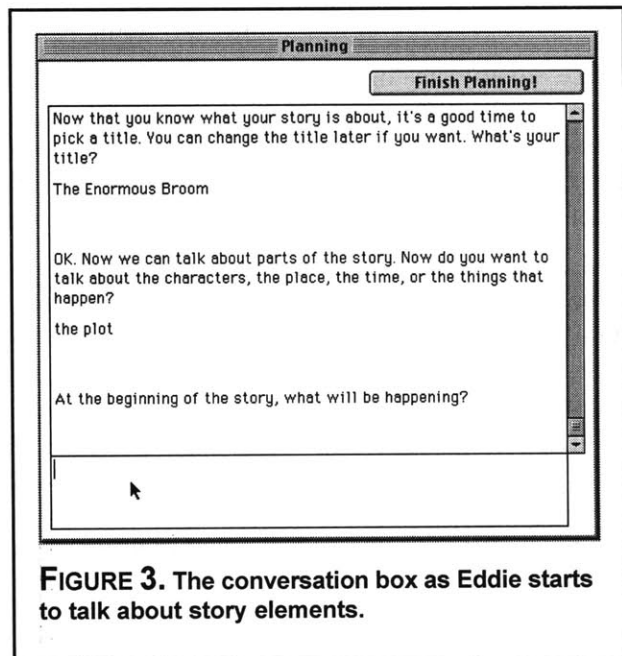


FIGURE 3. The conversation box as Eddie starts to talk about story elements.

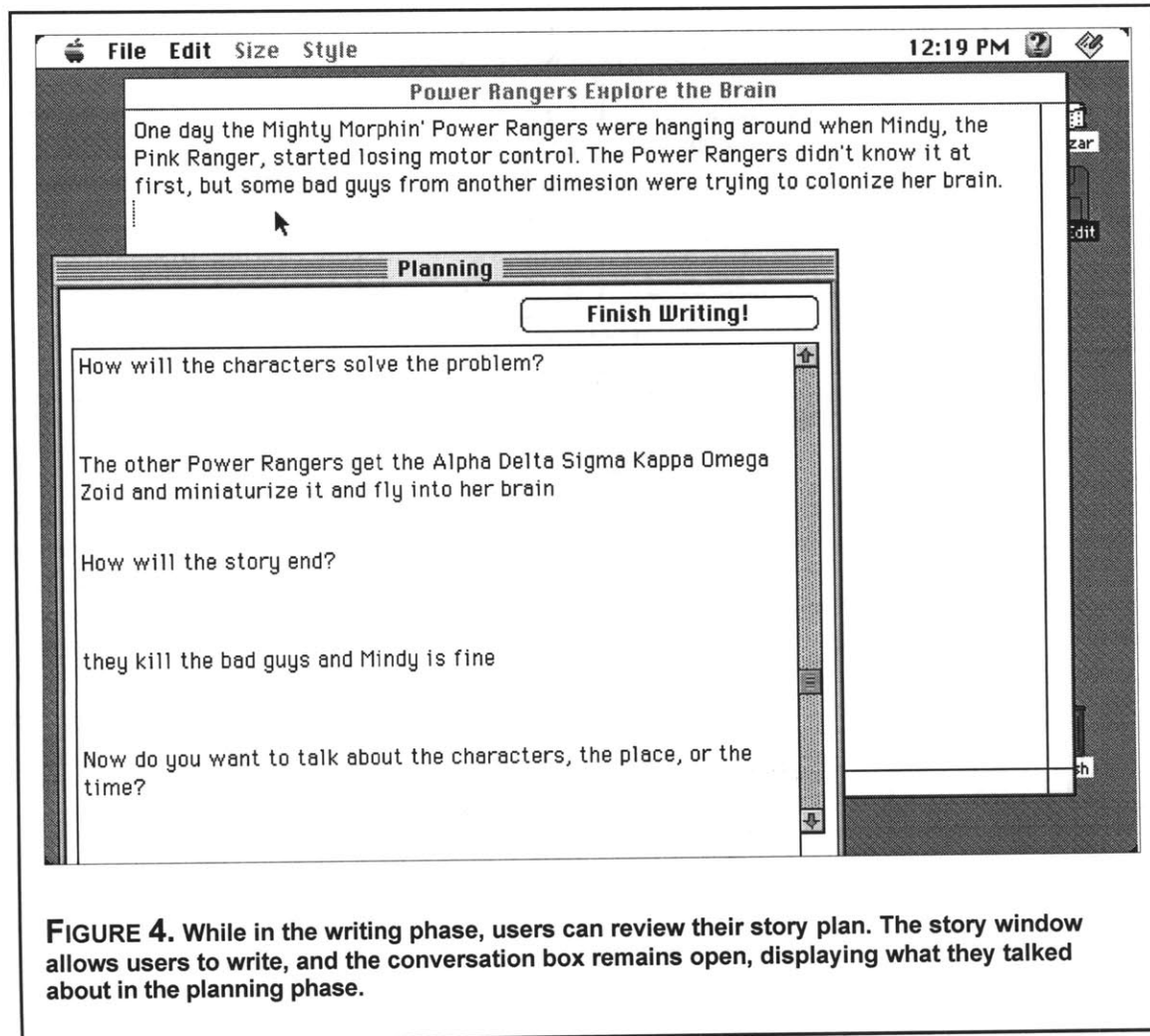


FIGURE 4. While in the writing phase, users can review their story plan. The story window allows users to write, and the conversation box remains open, displaying what they talked about in the planning phase.

responses. The list will grow no further. At any point, before or after the conversation has ended, the writer can scroll through the conversation to review what has been said. The writer can also move to the next phase at any point.

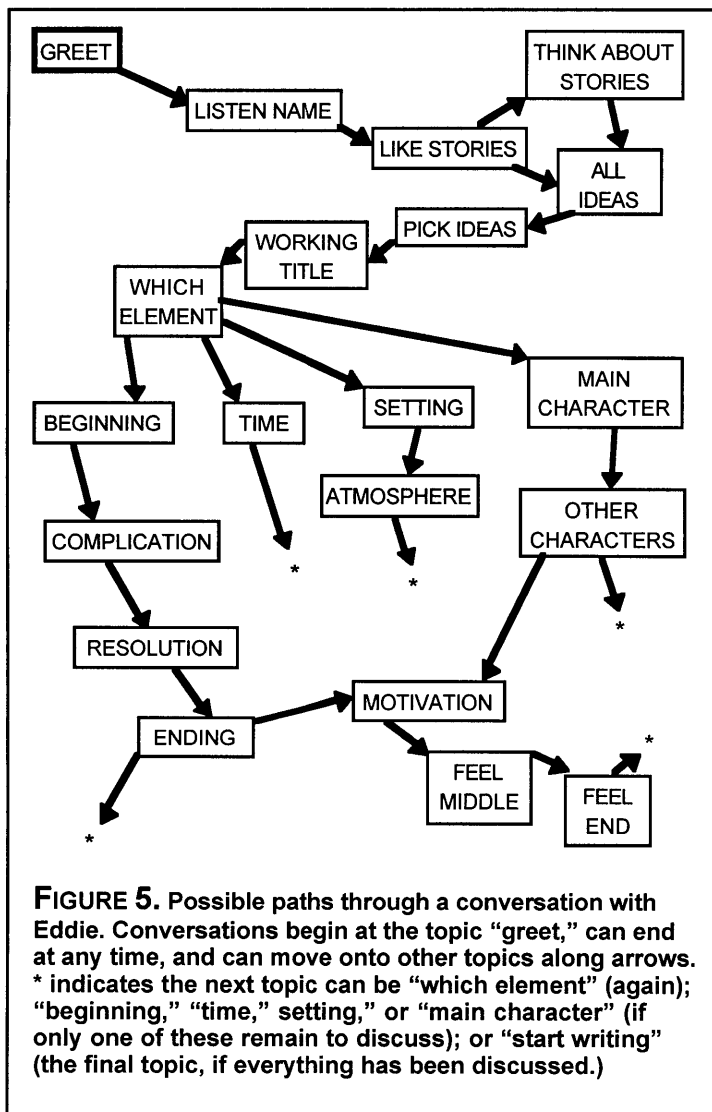
During the writing phase the writer cannot continue the conversation with Eddie by typing in the bottom section of the conversation box, but this box remains visible. It is still possible to scroll through the list and read the conversation, so EddieEdit users can look back at their story plan just as StoryStages users can.

Eddie allows the writer to select the order in which character, setting, time, and plot are discussed. As in StoryStages, conversation with Eddie is not compulsory and the writer can move on to the writing phase without doing any planning at all.

The conversation engine keeps track of goals the Eddie has that are specific to the planning and revising stages. In both stages, these goals correspond to delivery of the prompts and

reply from the user. After the writer replies to Eddie's question about the main character, the "main character" goal is satisfied and Eddie will move on to the next topic.

This allows a sort of primitive memory of what has been accomplished in the conversation. Eddie will not ask about the main character's feelings at the end of the story until the conversational prerequisites have been discussed. In this case, Eddie must have already asked about who the main character (during discussion of character) is and how the story is going to end (during discussion of plot).



The conversation engine will produce a few yes/no questions. As an icebreaker, Eddie asks if the writer likes writing stories. A procedure in the conversation engine examines the reply to determine if it is yes, no, maybe, or some other response. Eddie can then reply appropriately, even though he will drive forward with the story writing discussion in all cases. If he is unable to understand, he can pretend to be distracted and ask the user to focus the conversation again on story writing. If he sees that the student using the software does not like story writing, he can mention that he will help and that perhaps he can make it more fun.

For the most part, Eddie's conversation engine has the ability only to ask a series of questions — a multilinear series in which the order is determined by the user's responses. Eddie can also determine the answer to a few of these that have very specific types of answers. The level of sophistication of Eddie's con-

versation is far below that of Eliza in terms of interactively, user initiative, and use of user reply. But Eddie's goal is to stimulate thinking about the story writing process better than a checklist can. His limited conversation ability may be enough to help children ease their

way from oral conversation to writing. His character is somewhat better-defined than that of the Rogerian/Freudian Eliza, who (by design) makes little of herself known. The more defined character of Eddie, revealed in Eddie's conversation with the user, can help children think about someone other than themselves as they write.

EVALUATION

“We’re lab rats, and we’re going to take over the world by writing stories!”

— Subject on the first day of the study

DESCRIPTION OF THE STUDY

The study was conducted for three reasons. First, the study aimed to determine, using methods of the learning sciences, whether or not a system using a conversational computer character can help to improve children’s story writing. The very small sample size would likely preclude conclusive results. Still, significant results from the study could indicate whether this research area is a fruitful one and could focus additional development of educational computer characters to help writing. Second, the study was meant to aid in software development, to provide feedback on the usability of the system and the way in which it would actually be used by children. The usability results could enable short-term improvement of the programs so stable, polished versions of them could be released to educators and students. Third, it was hoped that all three pieces of software would work well enough to afford some educational benefit to the students who wrote with them. The combination of this educational goal with the scientific and software development goals makes the quotation above particularly apt.

Accomplishing the first goal involves empirical evaluation of the writing improvement made by children using EddieEdit and that improvement made by children using StoryStages and E-Write. StoryStages was developed to be a control, and it has the same tutorial information about story writing as does EddieEdit. It simply lacks the conversational character interface. Since the particular planning and revising prompts used may not themselves be effective, E-Write provides an additional control. Because the study is to evaluate the cognitive effects of, not with, the software, the stories evaluated to determine improvement were written before and after the main sessions in which the software was used.

The study was conducted at a public elementary school in Cambridge, Massachusetts. The study ran from March 18 to April 3, 1998. It took place in the school’s computer lab, where students used PowerMacintosh 5200/75 LC computers with 12 MB of RAM, running System 7.5.3.

Eighteen students from one grade 2/3 classroom participated in the study from start to finish. All of the stories written by children were saved for analysis. To preserve the anonymity of the subjects, the names of subjects were removed from stories and replaced with a code before anyone other than the experimenter examined them.

The complete procedure was as follows:

1. The parents or guardians of subjects read a letter that describes the study and includes a consent declaration.
2. The study was described to subjects, who were then given instructions and asked to fill out the pre-writing questionnaire.
3. Subjects each wrote a story during a class session, using a familiar school word processor, ClarisWorks. They were given forty minutes.
4. Subjects were assigned to three groups of six students each based on a rough estimate of their writing ability. This estimate was based on the one story they had each written, and was done to avoid extreme clustering of low- or high-ability students in one of the three groups.
5. At the next class session, the groups were assigned colors corresponding to E-Write (Red), EddieEdit (Blue), and StoryStages (Green). Each student wrote for the next eight classes using the same assigned system. The experimenter offered no assistance whatsoever in using the software, although did offer to intervene if the system needed to be restarted or if there was a chance of data loss. Subjects had to rely on the introductory and help screens, and on assistance from the teacher and staff. These types of help were uniform for all participants. The groups were as physically separated as possible within the computer lab, each occupying a row.
6. During the final class session, subjects again each wrote a story, using the same familiar school word processor, ClarisWorks. They were given forty minutes, the same amount of time to write as in step 3.
7. Subjects were thanked and asked to fill out the post-writing questionnaire.
8. The investigator explained to subjects what the goals and procedures of the study were, in detail.
9. After analysis of data, the results are also described to the teacher, parents, and subjects. Copies of all the stories written by a particular subject are given to that student on disk, along with improved versions of EddieEdit and StoryStages.

The author conducted the experiment. He did not provide help, either on use of the software or on writing, during the course of the study. However, it was necessary to interact with students during the writing time in several cases. When a student closed the writing program, which was on floppy disk, it could not be restarted by the student. The experimenter had to enter a code on that computer to disable a security feature, unlocking the floppy disk and allowing the execution of programs on floppy. This allowed the program to be run again. In one case a student erased his story unintentionally and the experimenter restored it from a backup. To not intervene in that situation would have interfered unacceptably with the third purpose of the study, to be an educational experience.

Students were not personally implored by the experimenter to write, but if they were distracting others or out of their seats they were told to return to their computers. While the row using E-Write was alone, those using StoryStages and EddieEdit sat in two rows back

to back. Students would sometimes turn around to see what someone in the other group was doing or to talk to them. The experimenter tried to deal with this by walking in between a distracted student and that student's object of attention. The experimenter received frequent requests for help using the software and for help spelling words, but he directed both of these sorts of queries to others, saying the student would have to ask someone else.

The teacher, an intern who assisted the teacher, and the school's staff member in charge of the computer lab all were present during most of the study and provided this sort of help. The experimenter encouraged these educators to help students in the ways they normally would. Since the software is for classroom use and meant to be used in this context, it is consistent with all the purposes of the study to have such adults providing help.

The last day planned for the study fell on a Friday. After two weeks of writing every day, several of the children were uninterested in writing stories. During what was to be the final evaluation of their story writing ability, some children started to create newspapers, drew pictures, and began typing everything using a symbol font. The experimenter believed the result was not representative of their writing ability, and the teacher and intern agreed. Another writing session was scheduled and after a day off the children were more focused on story writing, although many of the students resented the additional session. The stories from this final session, rather than from the last scheduled session, were the ones used in the analysis.

COMPOSITION OF THE GROUPS

The 18 children who participated in the study from start to finish included both second and third graders. All were in the same elementary school class. The students were of varied races. The student sample consisted of 11 boys and 7 girls.

Answers on the questionnaires indicated a high level of previous computer experience. Specifically, all but three of the students wrote that they had a computer at home. Students were asked "Have you used computers before?" and could answer from 1 (no prior computer use) to 5 (constant computer use).⁷ All students answered either 3, 4, or 5. The mean value for students' answers was 4.3 with standard deviation of .8. Students were asked about the specific activities they had done on computers, and given a list of six activities as well as the option to write additional ones. All students indicated at least three activities. All of them wrote that they had played computer games. Thirteen of them wrote that they previously used the computer to write stories. In the "other" category, activities listed ranged from homework to "hacking." In reply to "Do you like to use computers?" all students answered either 3, 4, or 5 on a similar scale. The mean answer was 4.7 with a standard deviation of .6. On the first day of the study, the students used ClarisWorks, a word processor designed for adults. The ease with which they used the functions of this software was consistent with their reports of familiarity with computer.

⁷ The complete questionnaire administered at the beginning of the study is titled "Beginning Survey" and included in Appendix A.

Students reported that, on average, they had written “some” stories before — more than “a few” but less than “many.” One student indicated he had not written stories before, while three reported that they had written “very, very many.” The mean answer on a 1 to 5 scale was 3.0 with a standard deviation of 1.3. The group enjoyed story writing for the most part, although not as much as computer use. On a 1 to 5 scale the mean answer was 4.2 and the standard deviation .9. In answer to the question “How do you write them?” only eight indicated that they type them on a computer.⁸ Fourteen of the students said they write stories with a pen or pencil. This set of students includes some who also use the computer to write stories, as some students indicated more than one method.

The students were divided into the three groups (Red, Green, and Blue, to use E-Write, StoryStages, and EddieEdit) so that the distribution of grade level and gender was similar in each group. The Red and Green groups each had four boys and two girls, while the Blue group had three of each. The Red and Blue groups each had equal numbers of third and second graders, while the Green group had four second grade students and two from third grade.

Students were also assigned to groups so that the groups would be roughly equal in terms of average writing ability and similar in terms of the distribution of writing ability. This was done by means of a brief qualitative evaluation of their initial writing samples, done by the experimenter. The avoided extreme clustering of high- or low-ability students in a single group. The distribution across groups was clearly not identical, but this was not problematic. The important attribute that should be evenly distributed among the three groups is ability to improve, not ability to write. It is improvement in writing quality, not absolute writing quality, that is the variable under consideration. Of course very high-ability students who know how to plan, write, and revise already, who are comfortable with writing at length, and who can envision an audience would benefit little from the educational interventions in this study. However, it is safe to assume at this age that most students can improve their writing at least a little when helped with these things.

Students were first placed in three unlabeled groups as indicated above. The three groups were then randomly assigned as Red, Green, and Blue and associated with the three pieces of software.

USE AND USABILITY OF THE SOFTWARE

Observation of the students as they used the software highlighted some particular problems and successes. The difficulties they had provide guidance for making both high-level changes in design and minor refinements. The way in which they used the software also revealed how well the software’s model of work flow was able to match up with and assist the cognitive process of the writer.

⁸ This can be interpreted as inconsistent with the answers of 13 students indicating they have used computers to write stories. This question asks whether a student has ever written a story on the computer, however, while the question “How do you write them?” may be read as asking for the usual method used to write stories, not every method ever used. Twelve of the students indicated only a single method.

EDDIE: OK. Now we can talk about parts of the story. Now do you want to talk about the characters, the place, the time, or the things that happen?
USER: YES
EDDIE: Sorry, I didn't understand. Now do you want to talk about the characters, the place, the time, or the things that happen?
USER: yes i do
EDDIE: Sorry, I didn't understand. Now do you want to talk about the characters, the place, the time, or the things that happen?
USER: Y
EDDIE: Sorry, I didn't understand. Now do you want to talk about the characters, the place, the time, or the things that happen?
USER: Yes
EDDIE: Sorry, I didn't understand. Now do you want to talk about the characters, the place, the time, or the things that happen?
USER: ok
EDDIE: Sorry, I didn't understand. Now do you want to talk about the characters, the place, the time, or the things that happen?
USER: characters
EDDIE: Who is going to be the main person in the story - the main character?

FIGURE 6. Eddie's limited conversational abilities are not enough to deal with this appropriate but unanticipated response from the student, who finally figured out how to respond with the help of the computer lab manager.

Children did at times converse with Eddie as they planned their stories. Children would bypass questions they didn't wish to answer but might answer others later. Sometimes, for instance, the questions about plot would all be answered "I don't know," but other replies would include description of elements which later appeared in the child's story. The two questions that ask the child to first brainstorm and then pick one or a few specific ideas usually resulted in puzzlement when they were first encountered. Children never wrote more than one story idea to begin

with, so Eddie's request that the user pick one from the list was unnecessary.

At one point Eddie asks "Now would you like to talk about the characters, the place, the time, or the things that happen?" Eddie then begins asking about the specific story element the writer chooses. Eddie can understand replies such as "plot," "the things," "what happens," "the place," "the people," "the characters." One child, who was carefully reading all of the directions and thinking about each of his replies, typed in response to this question "yes." This is not a response Eddie understands in this context, so Eddie simply indicated his lack of understanding and asked the question again. The question is probably phrased poorly and this experience indicates that Eddie's handling of a response like "yes" is not adequate.

Although the on-screen directions indicated that the user should press return to finish typing a reply to Eddie, some children had difficulty with that. A "Tell Eddie" button may have helped to alleviate this problem. In general, the on-screen directions were too lengthy for children to read entirely. Yet the absence of graphics did not prevent children from finding commands on the menu bar or using the checklist or conversation boxes. It did not seem necessary to have graphical elements in the interface to make the software easily usable by children.

Many children skipped conversing with Eddie and began writing immediately. This was also the case with the writing prompts in StoryStages, although more writers used these initially. Few children used the revision prompts of Eddie during their first writing session. During the first few days, many closed the program while still in the writing phase and began a new story. They saved what they had done but never moved on to the revision phase. The process of moving from phase to phase and confirming that the move is desired was not particularly smooth and led to some hesitation at first. Still, children learned fairly quickly how to advance to the next phase.

Students did not complain about having to close the program and open it again to write a new story, although this process was somewhat cumbersome. It was worsened because the experimenter had to unlock the desktop each time the program had to restarted, since a security program would have otherwise prevented programs being run from floppy disk.

The lack of font control and more extensive control over styles led some students to complain during the study. Some students wanted to know if their story was longer than a page and not being able to see the pagination bothered them. To achieve additional effects, some students typed while holding down the option key to produce symbol characters. Other students pressed the function keys. This created squares at the insertion point on their screen. These squares were not printable characters, however, and did not show up on the printout. This surprised some students who had created patterns with the squares in their stories. One E-Write user had a more severe problem with the display. He reached an impasse when he became troubled by being unable to see the ascender on his lowercase d. The d was italic and at the end of the text, and Macintosh TextEdit clips a portion of italic characters when displaying them. The student called for help from the teacher, erased and re-typed the d several times, and did not do additional writing for several minutes while he tried to deal with the perceived problem. Good control over formatting and accurate WYSIWYG screen display were clearly important issues, perhaps even the dominant issues, for this group.

WRITING DONE IN THE THREE GROUPS

EddieEdit and StoryStages were designed to be useful tools for writing stories, but their main purpose is educational. Even if a child does not use the software when writing a story, the experience of having used it should provide a lasting benefit. To discern whether such a benefit was seen, it is necessary to differentiate the cognitive effects *with* the software from the cognitive effects *of* the software (Salomon 1990). The stories written during the study shed light mainly on the cognitive effects *with* the software. Yet it is still useful to examine the stories written during the study. Stories are automatically saved in different sections of the story file as students enter a new phase. This means some interesting indicators of the writing processes of users may be captured in the files from EddieEdit and StoryStages. Saved along with the text of the stories are children's conversations with Eddie and their responses to StoryStages planning prompts. Also visible are the state of the stories at each phase of the writing process. So it is possible to see whether the StoryStages or EddieEdit students revised more during the revision phase as they used their programs.

EDDIE: Hi again! I guess you wrote your story. I have a few more questions that might help you. Have you ever made changes to make one of your stories better?

USER: no

EDDIE: Really? Even great stories can be made better. I change mine a lot. Let me ask about the beginning of your story. Do you think your first sentence is really good?

USER: Yeah

EDDIE: Great! If you make it better it will be really super. If you want to, try to write one that is even better.

USER: no

EDDIE: OK, now let's talk about the end. That's what the reader will remember the most! Do you think the ending is really good?

USER: no

EDDIE: I bet you wrote a good ending. But if you don't like it that much, the best thing to do is write a better ending. Go ahead, think about how you could make it better. Then, write a better ending.

USER: ok

EDDIE: OK, now let's talk about characters - and how they feel and think. I'm sure you wrote about what the characters do. Did you also write about how they feel, and what they are thinking?

USER: Yes

EDDIE: That's very good! That's what makes characters seem real. If you want to, you can write more about how they think and feel.

USER: no

EDDIE: OK. Now, read your story. Is everything that happens very clear? Sometimes it helps to add some sentences to explain. That can make the story easier to understand. What could you add?

USER: Nothing

EDDIE: Well, that's about all I can tell you. Go over to the story window now and make all the changes you want to make. Then, come back and tell me: How many changes did you make?

USER: 54,000,000

EDDIE: Any changes you make can make the story better. I have to go now. I hope I helped you a little. Bye!

Figure 7. A typical conversation with Eddie about revision. At least the student's responses indicate he is reading Eddie's text.

While this information only reflects how children write while using the tool, it can also provide clues about how they might be changing the overall way they think about writing.

Although responding to the prompts was not required, almost all the StoryStages and Eddie-Edit users did use the prompts to plan at least one story. None of the StoryStages users typed any answers to the revision prompts, but EddieEdit users did talk to Eddie about revision. Although they read everything Eddie had to say, none appeared to actually revise their stories based on his suggestions.

The main result obtained from the saved StoryStages and Eddie-Edit data is that the sequential process model, in which students must start in planning mode, move

to writing mode, and finish in revising mode without ever backtracking, is inadequate. Many users wrote large amounts even after they had "finished" their story — that is, completed the revision phase. Others began planning, progressed to the writing phase, and found that they wished to continue planning but could not. They had to begin another story and re-start their planning. In the StoryStages group, most quit the program without ever going to the revision phase, simply quitting when they felt done and starting another story. Because children were able to circumvent the unworkable model of sequential writing phases, sections of the saved stories could not be simply compared to see how much

revision was done on each story. Students did not do revision while in the revision mode, although some made changes after writing. These stories do provide a important record, since they indicate that some of the children often wished to return to a writing process from an earlier phase. As children discovered the irreversible progression and the nature of the different phases, the EddieEdit and StoryStages users who used the planning feature started to do all of their planning before moving on. They stopped abandoning stories to start their planning process over. But some students skipped the planning phase after initial frustration with it, and since they were unable to go back, never learned to take advantage of it.

STORIES WRITTEN AT THE BEGINNING AND END

In this study there was one initial and one final writing session in which the children all used a familiar word processor, ClarisWorks. The hope was that by comparing the two sets of stories written during these sessions, it might be possible to get a rough idea of how much each group improved. Several studies which assess improvement in writing ability employ this method (Daiute 1985b, Keetley 1995). These two studies did span months rather than weeks. In two weeks, improvement may not be discernible. These studies also had the children hand-write stories at the beginning and end. Using a word processor for the initial and final sessions appeared to be a better option than asking children to write with pencil or pen. The students were all computer-literate, and the control group here was doing word processing throughout the study.

To evaluate improvement in writing, students wrote stories at the beginning and end of the study using a familiar word processor, ClarisWorks. This method of gauging writing improvement is problematic if there is only one initial sample and one final sample, as there were in the studies mentioned above and as there was in this study. The quality of writing during a particular session may vary greatly from day to day because students have a different expectation, mix of activities, and ability to concentrate each day. If students are placed in a very formal testing atmosphere in both situations, these variations can be diminished. However, such an evaluation may still do a poor job of measuring creative writing ability, since the quality of a creative writing sample on a given day can depend on many factors extrinsic to ability.

In an attempt to make the initial and final writing situations similar and fairly informal, students were led to the computer lab on both days and simply instructed "write stories." They were additionally told that it was OK not to finish, but that they should concentrate on writing during the whole session. The initial evaluation went fairly well. The first attempt at a final writing evaluation occurred after two weeks of daily story writing using the study's three programs. By this time students were bored with writing and easily distracted. Many of them played with ClarisWorks features that were absent from the study's three programs and did not write stories as instructed. So another session was held to attempt a better assessment. At this point many students were very resistant to writing more stories. One said "this project is over!" and others said they would refuse to write stories. No one of the three groups exhibited this reluctance to write more than the others, and in the end, they did all write stories during this second attempt at a final session.

This final writing session had some additional important differences from the initial session. The teacher provided help to students, typing for at least three students in the E-Write group and one student in the StoryStages group. So four of the students dictated portions of their stories rather than typing them. Students in the EddieEdit group received no typing help from the teacher.

The stories written at the beginning and end of the study were analyzed in two ways. The experimenter examined both quantitative features (number of words, number of characters, and average word length) and the evaluations that two story experts made of each story. Additionally, the presence or absence of 11 story elements, related to the 15 planning prompts, was noted for each story. The number of story elements each child used in the initial and final story were compared.

The two story evaluators were Kevin Brooks and Marina Umaschi Bers. Brooks holds a Master of Arts in communication. He tells stories professionally in the Boston/Cambridge area and has led workshops on storytelling. Bers holds a Master of Education in Media and Technology, and a Master of Arts in Media Arts and Sciences. Both develop interactive story systems and are doctoral candidates at the MIT Media Lab.

There were no criteria provided to the two story experts for evaluating the stories. They were given an instruction sheet that asked them not to consider how much they personally liked or disliked the subject matter of the stories. The sheet indicated that they should formulate their own criteria for ranking and that they would be asked afterwards to describe how they each ranked the stories.⁹ Neither of the evaluators had seen the prompts that StoryStages and EddieEdit used when they evaluated the stories.

The two evaluators formulated criteria that differed in details but were similar overall. Bers wrote in an email that she checked to see “if the stories had an introduction, a middle part, and an ending.” She also considered the description of characters, “the building of a conflict and its resolution and ... the internal coherence of the story.” She wrote that length was not one of her criteria. She added that some stories which were unfinished were nevertheless evaluated by her with a high score because she could see that they met her criteria. Brooks wrote that he used three main criteria:

- 1) Temporal coherency — do the events in the story have a clear temporal order.
- 2) Object detail — were there objects and places in the story that were described in more detail than barely necessary. ...
- 3) Motivation and causal connections — did the actions of the characters in the story make sense.

He added that he also considered whether or not the story was complete and came to “a sensible end,” but that he didn’t consider this as much as the three main criteria. Brooks wrote that spelling, punctuation, and length were not considerations.

In numerous studies Bereiter and Scardamalia “have always found number of words to correlate substantially with any indicators of quality or maturity applied to writing ... it

⁹ This instruction sheet is included in Appendix A.

seems to be a robust empirical generalization about school-age children doing school-type writing tasks” (Bereiter and Scardamalia 1982). This generalization did not apply strongly here, perhaps because the students’ story writing was not very similar to a usual “school-type writing task” despite taking place during school. Length in words and Brooks’s quality rankings were correlated with a coefficient of .63. Length in words was correlated with Bers’s quality rankings only with a coefficient of .42. In contrast, the correlation coefficient of the two sets of quality rankings was .75, even though the evaluators worked independently using different criteria. Since length in words did not appear to be a good measure of writing quality, the change in story length from initial to final writing sample was not analyzed.

Over the long term, increases in average word length may provide a clue to the underlying linguistic development of elementary school writers. Increases in average word length were extremely slight for the two week period (.22 characters for all groups) and unrelated to the quality rankings by Bers and Brooks, with a correlation coefficient below .07. So although quantitative properties of the stories were examined carefully, none were worthy of statistical analysis.

The evaluators’ rankings, being moderately correlated with a correlation coefficient of .75, did seem to merit further analysis. The two evaluators are highly qualified. These two independent evaluators, having different criteria for story quality, agreed to a great extent, strengthening the claim that their rankings are

	Improvement (10-point scale)						Average Improvement	Variance in Improvement
Rated by Brooks								
E-Write	6	3	2	0	-2	3	2.0±1.0	7.6
StoryStages	1	0	0	1	1	3	1.0±1.0	1.2
EddieEdit	0	-2	1	1	2	0	0.3±1.0	1.9
Rated by Bers								
E-Write	6	6	0	3	-1	3	2.8±1.0	8.6
StoryStages	-4	1	-3	2	7	1	0.7±1.0	15.5
EddieEdit	-1	-2	1	0	1	-4	-0.8±1.0	3.7

FIGURE 8. Based on Brooks and Bers rankings, the E-Write group improved, the StoryStages group stayed about the same or improved slightly, and the EddieEdit group stayed about the same. The improvement differences were not significant ($p < .33$, $p < .15$).

good indications of an underlying feature, story quality. Brooks and Bers both ranked the E-Write group as having the greatest improvement and the EddieEdit group as having the least, though variance in improvement was very high. The 1-10 ranking scale had granularity of 1, leading to .5 uncertainty for each ranking. So the scores for improvement, the difference in rankings, had uncertainty of 1. Considering only the uncertainty, the results show approximately no improvement in the StoryStages and EddieEdit groups and improvement of about 2 or 3 gradations in the E-Write group. However, the variance within the three groups was almost as great as that between groups. A single factor analysis of variance in Bers’s improvement rankings, using experimental group as the factor, was not significant ($p < .15$). For Brooks’s rankings there was also no significance ($p < .33$).

To determine whether one group began to include more of the story elements described in the prompts, the stories written at the beginning and end were examined by the

experimenter. For each story, the presence or absence of each of 11 story elements was noted. These elements, based on the 15 prompts in StoryStages and EddieEdit, were:

1. Main Character
2. Additional Characters
3. Setting
4. Description of Setting — for example, anything that would distinguish the “house” or “woods” mentioned from any other house or woods
5. Time — anything to hint at when the story took place; “once” does not count, but “a long time ago” does
6. Beginning — one event is mentioned in the story
7. Complication or additional event — something else happens; it need not be a problem
8. Resolution — characters do something to solve the problem or fail to solve it
9. Ending — the story is wrapped up rather than stopping in mid-sentence
10. Motivation — something suggests why a character takes action
11. Reference to Feelings — something mentions or refers to how a character feels or what a character thinks

No story had all eleven elements, although one had 10 of them. One piece of writing did not describe any events or characters or mention a place or time, so it had none of these elements. After all the stories were examined for the presence or absence of these elements, the total number of elements present was figured for each story. For each student, this total for the final story was subtracted from this total for the initial story to yield the *change in number of story elements*. This was positive for students who included more story elements in their final story than in their initial story.

This measure was not meant to be an indicator of story quality, but it should be the case that students who learned about story

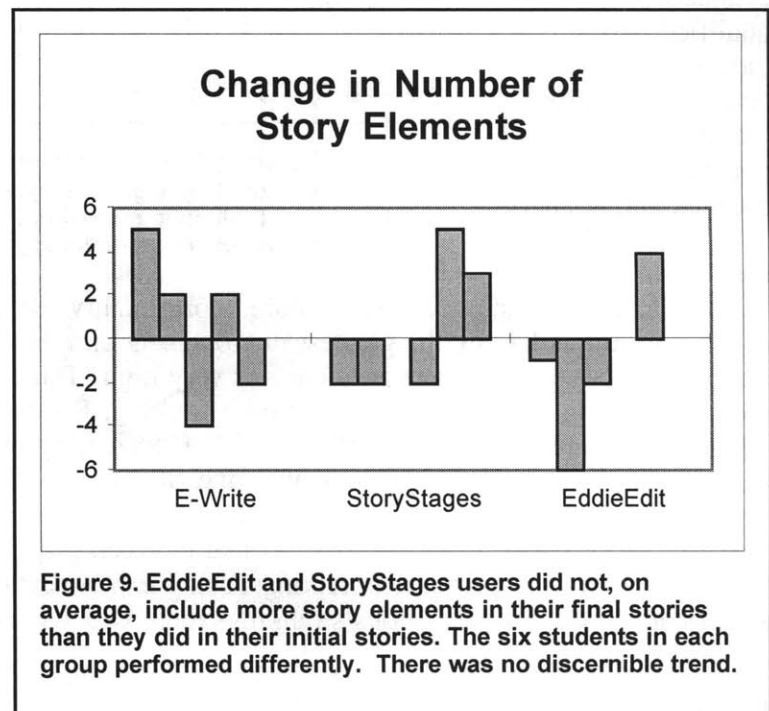
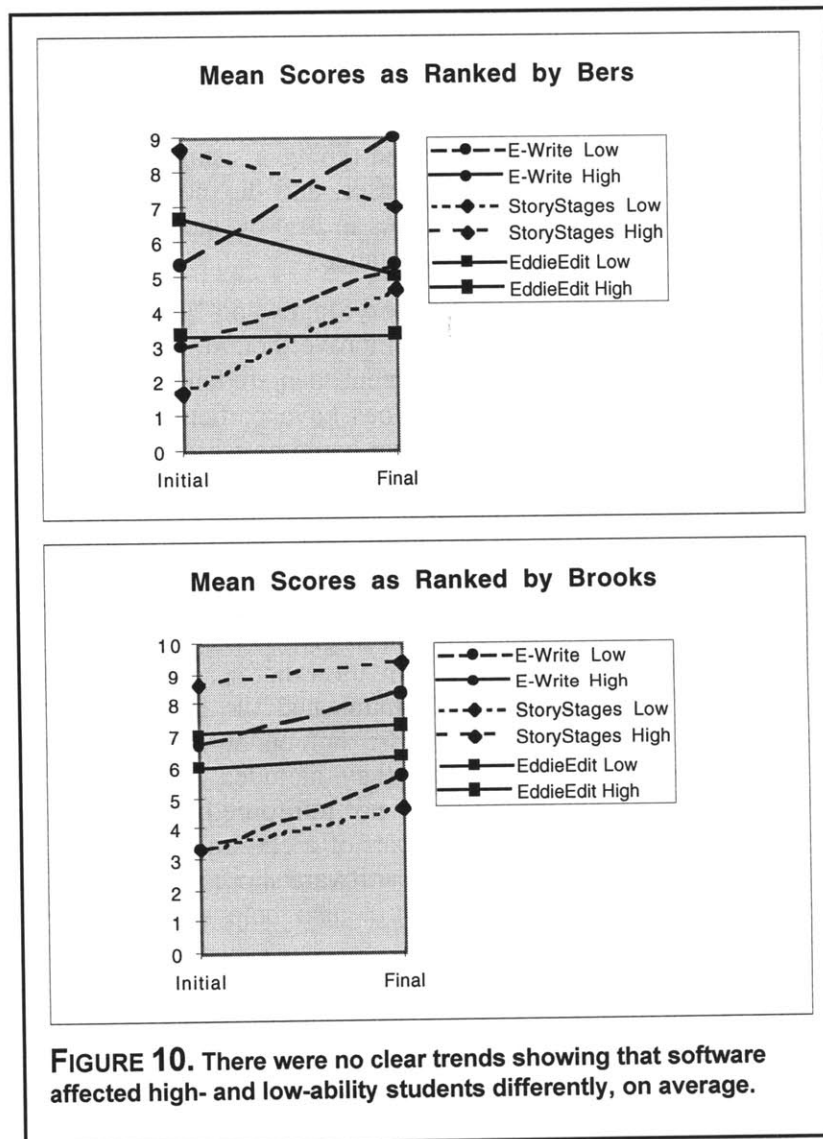


Figure 9. EddieEdit and StoryStages users did not, on average, include more story elements in their final stories than they did in their initial stories. The six students in each group performed differently. There was no discernible trend.

elements from StoryStages and EddieEdit will be more likely to include those story elements when writing their final stories. Considering the total number of story elements is somewhat problematic because students were not told or encouraged to write complete stories. Students who did not complete their story always did not have an ending and often also lacked a resolution. Additionally, stories with a single character or that do not occur at a particular mentioned time can be very good stories. Still, if StoryStages or EddieEdit were particularly effective in enabling students to learn about story elements and encouraging them to incorporate those elements in their stories, there should be a visible difference in how many elements were included in the initial and final stories.

There was no such difference. On average, the EddieEdit group included .8 elements fewer at the end than at the beginning. StoryStages users included, on average, .3 more elements, and E-Write users .5 more elements. The variance within groups was very high, however, as Figure 8 shows. The EddieEdit group's overall decline in number of elements was due to a single student who said he could not think of anything to write during the final session, and did very little writing. On the other hand, only one student in the whole EddieEdit group included more story elements (4 more) at the end than at the beginning. As a result of the high within-group variance, there was no significance to the slight variation between the three groups of users ($p < .73$).

There may have been little average improvement because the software helped high-



ability students but didn't improve, or perhaps even worsened, the writing of low-ability students, or vice versa. Although the small sample would preclude significance, to determine whether any such general trends were present, the mean scores of high-and low-ability students in each experimental group were plotted. Ability level was determined based on the rankings by Bers and Brooks of students' initial stories. Within each group, all of the students improved as ranked by Brooks. Some improved and some worsened, as ranked by Bers, with the most dramatic difference being between high-and low-ability StoryStages users. Given the high variance even within high- and low-ability groups, and lack of a similar trend in Brooks's rankings, it did not seem that the software affected high-and low-ability students differently.

The EddieEdit and StoryStages users, as a group, did *probably* produce stories that showed slightly less improvement in the final story writing session. The variation in all measures of quality and regarding use of story elements is extremely high within the three groups. It is almost equally likely that the differences in improvement between the EddieEdit, StoryStages, and E-Write groups is due to chance. Even if the EddieEdit and StoryStages groups did write stories showing less improvement, this does not mean they improved less. The teacher provided typing assistance to several E-Write users, provided this assistance to one StoryStages user, and did not provide this assistance to EddieEdit users.¹⁰ The insignificant differences in improvement that were observed probably reflect only this distribution of typing assistance.

The question remains as to why StoryStages and EddieEdit users did not use more of the story elements they read about to improve their stories. A further issue is why EddieEdit users did not show more improvement than students in the control groups, if indeed the conversational character interface does have particular benefits for young writers. In the former case, better design of software could better teach about story elements. In the latter, the subtle assistance that a conversational character may provide is likely too slight to measure over a two-week period.

The software used in this study may have been inadequate to teach students how to employ story elements in their writing. It was not designed primarily to teach about story elements. Instead, story elements were chosen to give Eddie something to talk about and to provide StoryStages with comparison information that it could present. Additional simple features could have more effectively communicated the importance of using story elements in writing. For instance, students were not encouraged to check through their plan *after* writing their story to make sure they included all the of elements. The use of story elements, although suggested, was not reinforced. It would also help to show students, either through the software or as part of a classroom activity, how the stories they enjoy use these elements effectively. The software should do more to encourage the use of story elements, and other activities should also help students learn about how to use these elements in their writing.

¹⁰ This could have been because former EddieEdit users were more motivated to write by themselves, without typing assistance, although many other factors could have contributed to this as well.

StoryStages and EddieEdit users also encountered difficulty with the unfamiliar features of the programs they used. Some features, particularly those relating to the progress through writing stages, were not well-designed in the original versions of the programs. These results serve as a warning that the educational interventions implemented in software, even if based on effective techniques, may be overwhelmed by other factors, such as problems with usability.

EddieEdit's particular interventions — whether sound or unsound — probably could not have had a measurable effect in two weeks. A longer-term study is needed to determine whether a conversational computer character can improve writing quality. An educational intervention that provides gradual assistance in acclimating a young writer to the particular nature of writing (as distinct from conversation) may simply not have an observable short-term effect on writing quality. Moving from command of oral language to the ability to write at length is a process that takes years, and looking at the changes that occur over two weeks provides little insight into whether a particular intervention is of long-term benefit. Whether a child has learned about particular story elements over a two-week period can reasonably be determined, but it would be hard to similarly assess a conversational character's subtle effects. If improvement in writing quality is to be the main metric for gauging the effectiveness of a program like EddieEdit, it must be kept in mind that the changes could be important but very gradual. Longer-term experience and more thorough initial and final evaluation is important.

RESULTS FROM THE POST-STUDY QUESTIONNAIRE

Nineteen post-study questionnaires were distributed to students. An additional student was included in the Blue group after the first day of the study. Her initial absence meant that she provided no initial writing sample and did not fill out a pre-study questionnaire. She did use EddieEdit throughout the session and provided useful usability and scientific data by responding to the final questionnaire.

All questionnaires asked about how the student liked the program used during the study and what could be done to improve it.

The questionnaires distributed to EddieEdit and StoryStages users included two questions not on the E-Write questionnaire: "What does 'revision' mean?" and "What are two things you think about when you plan a story?" The EddieEdit questionnaire also included the additional question "Who is Eddie?"

The complaints on the questionnaires were mostly about the lack of formatting ability, echoing the complaints made verbally during the study. One EddieEdit user indicated

"There weren't enough fonts like on ClarisWorks."

—StoryStages User

"it doesn't show the pages"

—StoryStages User

"no fonts not enough sizes not enough tools"

—EddieEdit User

FIGURE 11. Answers to "What did you really NOT like?" most frequently mentioned the lack of formatting ability.

he did not like planning. Except for this comment, and comments about things extrinsic to the software, all other complaints dealt with the lack of font control, pagination, and formatting features. In addition to those who wrote specific complaints, one StoryStages user who simply wrote that he did not like “everything” indicated that the program could be improved with “More fonts, tools, sizes, and features.” So his dislike of the software probably also stemmed from the lack of formatting control.

Half of the students in the StoryStages group indicated that their favorite feature was the checklist box and its prompts. Two responded to “What was your favorite thing about it [StoryStages]?” with “the questions” and one wrote “It gave me lots of ideas.” No StoryStages users specifically complained about the planning and revision prompts. One student in the EddieEdit group indicated he did not like planning, but another wrote that planning was her favorite feature because “if your writing a story you will all ready have everything planned out.”

Students were asked if they liked the program they used and could answer from 1 (“No! It was lame.”) to 5 (“Yes! It was really great!”). Students were also asked if they would use the program at home and could answer from 1 (“No way!”) to 5 (“Yes! I’d use it a lot!”). In each of the three groups there was one student who gave the most negative reply to both questions. None of the E-Write users gave strong positive replies to both questions. In the StoryStages group, one student answered with the strongest affirmative to both questions. In the EddieEdit group, three of seven students answered with the strongest affirmative to both questions. So while each program had a strong detractor, EddieEdit had the largest proportion of enthusiasts.

There was certainly no consensus about the programs, and responses were very widely distributed. Even the difference between the like/dislike rankings of the two most differentiated groups, E-Write and EddieEdit, is not significant ($p < .35$). On average, though, EddieEdit and StoryStages were slightly preferred over E-Write. Students were ambivalent about E-Write. The mean like/dislike of E-Write was 3. StoryStages and EddieEdit were both better liked on average with mean like/dislike ratings of 3.7. This .7 difference on a 1-5 scale is not statistically significant and does not demonstrate the students preferred EddieEdit and StoryStages. Still, it is heartening to note that EddieEdit and StoryStages — which had unfamiliar features, asked children to do something besides the usual writing, and had several usability problems — were not ranked significantly *lower* than the simple word processor.

Students did not suggest any improvements related to EddieEdit’s or StoryStages’s planning and revision features. They did indicate that features like spell checking, text formatting control, and the ability to draw pictures should be added.

None of the students answered that it was hard to write with any of the programs. One EddieEdit user changed one of the answers to indicate that it was hard for her to write with any computer. The others all either indicated that the program they used made it easier to write or indicated that it was already easy for them to write stories.

Most students did not mention any story elements when asked about what they think of when they plan. The four StoryStages users who listed things wrote “What it will be

What does “revision” mean?

StoryStages Users

- “I have no idea!”
- “I dont no”
- “I don’t know”
- “I don’t know”
- “I don’t know”
- “Beats me”

EddieEdit Users

- “looking back and improving”
- “Going over the story”
- “I don’t know”
- “To see again.”
- “going over the story”
- “I do Not know”
- “When you change it to make it better”

FIGURE 12. Several EddieEdit were able to define revision at the end of the study, while no StoryStages users could.

about,” “the beginning & the end,” “killing and mystery,” and “Mysteries and scary stories.” The four EddieEdit users who listed things indicated “The ti[t]le and the words,” “whats the story going to be like,” “the place and the time” and “The beginning, middle, and end.”

Simply asking for the definition of “revision” produced the most striking result. EddieEdit and StoryStages had identical information about revision. StoryStages presented all of this information at once to a writer upon entering the revision phase. EddieEdit offered to begin a conversation about revision upon entering the revision phase. Only if the writer typed back to Eddie would the additional information about revision be displayed in the form of conversation. Yet at the end of the study, none of the six StoryStages users were able to define the term “revision,” while five of the seven EddieEdit users offered

good definitions.

Why did EddieEdit users learn something about this part of the writing process, while StoryStages users did not? The conversational character interface, although not resulting in improvement in writing quality, did seem to better engage EddieEdit users with the information about writing process that was provided. StoryStages users were presented with the whole list of revision prompts at once, but often just glanced at these and quit the program. EddieEdit users were invited to read this information a bit at a time, in conversational format, by typing replies to Eddie who would then respond with additional revision information.

The users of EddieEdit all did not get a good idea of who Eddie is, however. They noticed that someone called Eddie was addressing them. One of them — who consistently skipped the planning phase and did not converse with Eddie at all during the study — asked “Who is Eddie?” on the second day. Although they all noticed Eddie’s presence, four of the seven wrote at the end of the study that they did not know who Eddie was. The others replied, “a character that’s supposed to help you,” “the story helper,” and “the guy who asks your name in EddieEdit before y[ou] begin your story.” None of the students mentioned that Eddie is a kid or an editor. It would have improved the interpretation of these answers if a comparison question like “Who is Bugs Bunny?” had been included. This way, it would be easy to see what type of reply a given child would give when asked to describe a known,

well-developed character. Still, it seems clear even without a comparison question that EddieEdit users did not get a good impression of Eddie the character.

Users' inability to describe Eddie could be due to inadequate development of Eddie's character. However, it was probably instead a result of EddieEdit's failure to adequately express Eddie's nature. If the things Eddie says vary more and include mention of Eddie's profession and references to Eddie's age, users could get a better impression of Eddie the character. Eddie could use some additional quirks, as those he did display were noticed and commented upon by the children using EddieEdit. Still, these quirks should be carefully selected to allow for more identification with Eddie without distracting from the writing task. Eddie does not need hobbies or sports interests in order to be a well-defined character, but additional references to those aspects of his character that are defined would improve how he is portrayed. A simple graphical representation, even one that is not animated, could also call attention to who Eddie is while still letting users focus on the textual conversation, where they would learn more about him.

FURTHER SOFTWARE DEVELOPMENT

The usability results from the study would be of little value if they were not rolled into additional development efforts. To create versions of StoryStages and EddieEdit that were stable, usable, and ready for release, additional development was undertaken. In addition, an interactive Web version of Eddie's planning conversation was created so educators and researchers can easily see what Eddie is like. This section documents only the development that was done after the study: improvements made to StoryStages and EddieEdit, and the creation of the Web version of Eddie.

IMPROVED VERSION OF STORYSTAGES

For both StoryStages and EddieEdit, a major identified problem was the inability to return to planning once one had moved on to writing. Planning, writing, and revising were phases in the first version of the software, but they are processes — *not* sequential phases — within the broader cognitive process of writing. As was demonstrated by the study, the model of these processes as sequential stages was inadequate for the task of fully introducing elementary school students to planning, writing, and revising. Children did learn about revision from EddieEdit, but if they had been able to move freely between the processes the flow of process would have made for a more usable and realistic program.

To allow for more freedom of movement between the three processes, the Planning and Revision boxes in StoryStages — two instances of the checklist box — were replaced with a single Story Thoughts box. Within this box users can choose planning, writing, or revision mode. The selection is made with a radio button control that allows the user to pick one of the three modes at any point. The current active mode appears in the window title and in static text inside the box.

In planning mode the editable planning list populates the box. In writing mode this same list is made non-editable and is condensed so that only the answers that have been written are displayed. A row of check boxes appears to the right, one for each item in the story plan. As students write, they can check off each item in their story plan to indicate they have included it in their story. If they go back to planning mode, the list expands and becomes editable again. They can change any item (in which case the check mark for that item is removed) or add new items. Providing these check boxes is a simple way to reinforce that the elements in the story plan should be included when writing.

In revision mode a different list with revision advice appears in the list area, and a similar row of check boxes appears to the right. Instead of having space for students to write in, the scrolling list simply offers advice on how students can directly revise their story. As they read the revision prompts, they can check the box next to each prompt to indicate they

have read (and hopefully applied the advice in) a particular item. At all times the main story window is open along with the Story Thoughts box, and users can begin writing immediately upon opening a file or starting a new story. The active process is indicated by the radio buttons and the window title.

The text instructions that appear along the way were edited down further and a brief documentation file was created for distribution with the program. The help system was improved and the help text revised to make it more focused, clear, and brief.

Additional changes, invisible to the user, were made. The increased stability and compatibility with older versions of the Macintosh Operating System, improved the use of memory, streamlined the file format for saved stories, and removed unused vestiges of SimpleText.

IMPROVED VERSION OF EDDIEEDIT

The main change in the improved version of EddieEdit was similar to the improvement made in StoryStages. EddieEdit's Planning and Revision boxes were also replaced with a single box, the Story Talk box, within which a user can freely change between planning, writing, and revision. Interaction in planning and revision modes within the Story Talk box are not exactly the same as in EddieEdit. There is now just one conversation, but the topic

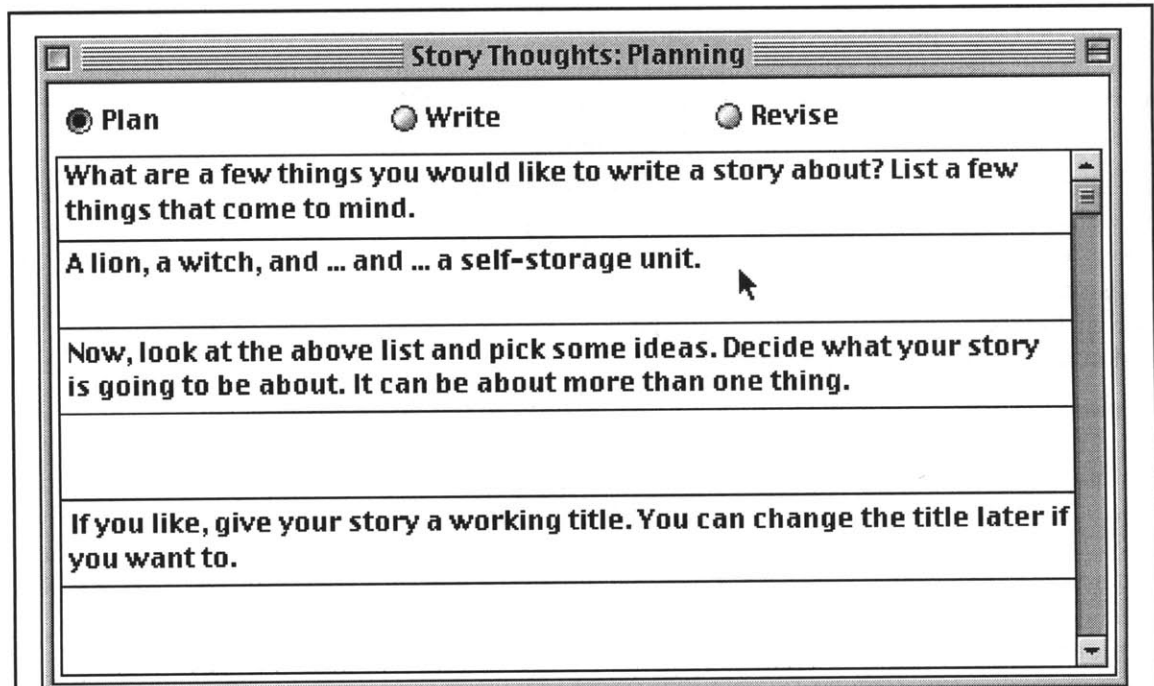


Figure 13. In the improved version of StoryStages, the Story Thoughts box means that users no longer have to progress irreversibly forward through writing phases. As in the improved version of EddieEdit, at any point the user can click a radio button to enter planning, writing, or revising mode.

can shift from planning to revision and back again. When a user moves to a different mode and comes back to continue a conversation about planning or revising, Eddie welcomes the user back to the conversation and mentions the current topic of discussion again. In writing mode the box has a summary of the planning portions of the conversation that contains the user's replies to Eddie and a tag to indicate what each reply is about. As in StoryStages, both the main story window and the Story Talk box are open at all times (once a file has been opened or a new story begun) so users can start writing immediately.

In addition, Eddie's conversational abilities were honed (although they remain simple) and his prompts were modified. This was done to avoid the problems that were observed in figure 6 and in similar interactions. The improved version of Eddie does not prompt the user for a list of ideas and then ask that that list be narrowed down, for instance. When asking the user to select which story element to discuss, Eddie now says "Tell me what you want to talk about now: either the characters, or the place ..." rather than "Do you want to talk about the characters, the place ..." If the user still answers with a simple affirmative, Eddie recognizes this and clarifies: "I'm glad you want to talk more, but you have to tell me what thing to talk about! Tell me one of these things: either the characters, or the place ..." A simple negative response is met with "OK, I'm not your boss. You don't have to talk to me, but if you want to, tell me what you want to talk about."

In the improved version of EddieEdit, a small picture of Eddie (a reduced version of the image in Figure 10) appears in the Story Talk box when the box is in planning and revision mode. In the writing mode, the user is not conversing with Eddie but rather looking over a previous conversation, so Eddie's absence is indicated by the absence of the picture. The simple image is placed there to clue users in to who Eddie is and invite them to find out more about him through discussion. It is iconic and cartoonish in keeping with the broad strokes with which Eddie's character has been metaphorically painted during character development. It is static rather than animated for both reasons of implementation convenience and to avoid calling undue attention to this non-textual element of the program. To tell Eddie what has been typed, the user of the improved version can either press return (as before) or click the "Tell Eddie" button.

EddieEdit's help text and integrated text instructions were also revised. They were reframed in an more formal tone so it would be clear they were supposed to be in Eddie's voice. The introductory text in the improved version explains who Eddie is in slightly more detail.

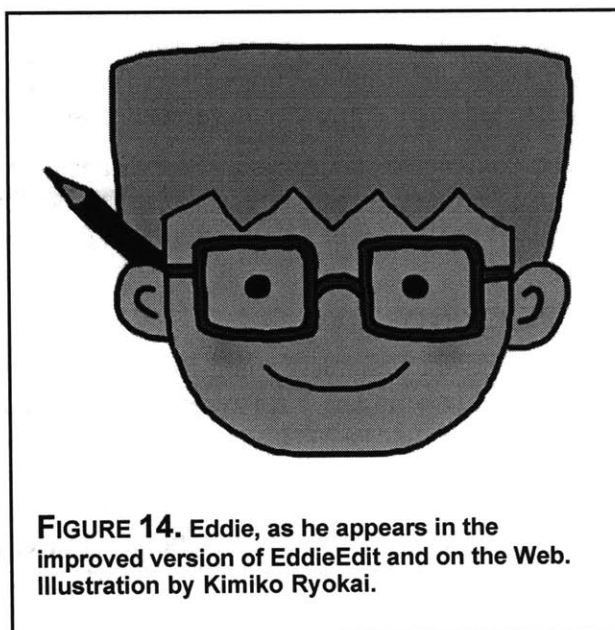


FIGURE 14. Eddie, as he appears in the improved version of EddieEdit and on the Web. Illustration by Kimiko Ryokai.

Brief documentation for teachers and parents was also written, mainly to explain the point of EddieEdit and how the program could be integrated into a child's classroom education or used at home. External documentation for students was not created since the help system was designed to be comprehensive in addressing how to use the software.

Changes were also made, as in StoryStages, to improve stability and compatibility, to better use memory, to streamline the story file format, and to clean up the adaptation of SimpleText to EddieEdit's word processing component.

WEB VERSION OF EDDIE

To make Eddie accessible on non-Macintosh platforms, extend his conversational abilities further, and make it easier for researchers and educators to see what a helpful computer character can be like, a Web version of Eddie was developed. This Web version can also provide something of a preview to those who may be interested in downloading EddieEdit, but it was not created for this purpose. Since the Web implementation of Eddie the Editor differs from EddieEdit in conversational ability, the Web system would be a somewhat misleading demonstration of the Macintosh application.

Because of this, the Web site indicates that this version of Eddie is different and that EddieEdit does not have the same range of conversational abilities. Both the Macintosh and Web characters were created to demonstrate what a conversational computer character created to help children improve their writing process is like. Because of this, improvements to either of these systems helps to achieve the main goal, even if the improved program is not the primary educational program.

The Web version of Eddie was developed in Perl, making it easy to expand Eddie's simple conversational skills. The changes made to the conversation capability were incremental, not revolutionary, but they did make the character a more effective conversationalist. The Web Eddie understands a wider variety of

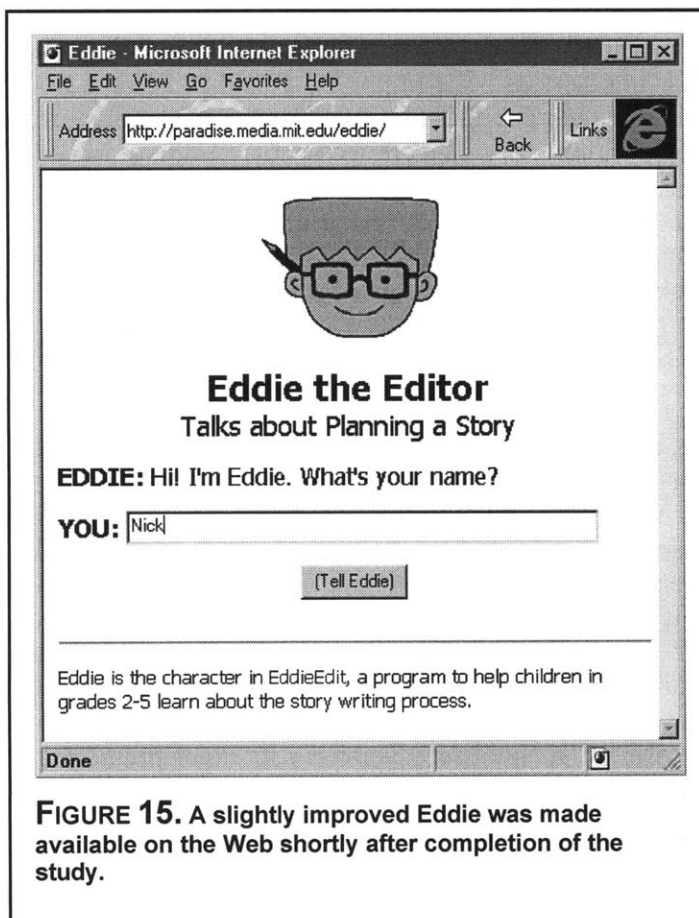


FIGURE 15. A slightly improved Eddie was made available on the Web shortly after completion of the study.

affirmative and negative replies and is able to better distinguish between one of these replies and a “maybe” or unrelated reply. Other changes improve Eddie’s rudimentary understanding and give this Eddie a bit more to talk about while maintaining the story writing focus.

Eddie can also vary his utterances a bit so he does not say exactly the same thing in each conversation. He has multiple versions of a few replies that he picks at random, each of which say about the same thing. These allow Eddie to use some language that distances him from what he says, such as “I think ...” or “I learned that ...” This not only injects a small amount of needed variety into what Eddie can say. It also makes Eddie less of an authority figure and more like the partner he is supposed to be.

While conversation is improved, the Web interface has its own set of limitations. There is no close integration with a word processor. Only the planning conversation is implemented. To maintain the conversation effect and to keep the page short, the entire conversation is not displayed at once. The user sees only Eddie’s last reply, although use of the browser’s back and forward buttons can allow a user to scroll through the conversation in a cumbersome way. Since it is intended to be a demonstration of what Eddie is like and not primarily a working educational system, these limitations are not problematic.

CONCLUSION

IMPORTANT OUTCOMES OF THE STUDY

The study yielded several important insights, but none of these came from comparisons of the initial and final writing samples. Some of the problems encountered in this part of the study provide insight into methodology. They suggest better methods for future work that tries to evaluate improvements in creative writing process and in the quality of creative writing. Other components of the study did have important results. Examination of how children used the software and reading what they liked and disliked indicated how creative writing systems for children can be better designed. Analysis of the post-writing questionnaire indicated that a conversational computer character can lead to greater awareness of some aspects of the writing process.

A Conversational Computer Character is Educationally Effective

The EddieEdit group's writing quality as measured did not change during the two weeks of the study. A longer-term study, with stricter initial and final evaluations of writing ability, is needed to determine whether conversation and interaction with a character help students imagine an audience and move from conversation to composition. The EddieEdit group clearly learned more about the writing process, however, as their answers to "What does 'revision' mean?" indicate. EddieEdit users knew the answer in five of seven cases, while none of the six StoryStages users knew. This was despite the fact that identical information about the revision process was present in both programs.

The delivery of this information in conversation, by a character, appears to have helped students understand it better. They seemed to engage more with the conversational character than with a simple list. They read and thought about what Eddie had to say, and then typed a reply. Because they were part of a conversation instead of simply the reader of a list, they made more of an effort to understand the text presented. Although students did not appear to actually revise as a result of the conversations they had with Eddie, they learned what the revision process was like from the conversations they had.

This clear positive result offers some hope that a conversational character can be an effective interface for teaching about the writing process, and perhaps easing the transition from speaking to writing as well. Improvement in writing quality did not indicate that such an interface is effective, at least over a two-week period, but the better understanding of revision that EddieEdit users had signals that this interface has some educational potential and deserves further exploration.

Improving the Design of Creative Writing Software

How children actually used the software, as discerned by direct observation and analysis of the saved stories with their additional information, provided ideas about how creative writing software might be better designed. The five main insights were regarding use of text as opposed to graphics, formatting ability, general usability, inevitable reappropriation by children of the software's function, and consistency with the actual writing process.

The programs were written in the Macintosh's graphical environment, but commands and buttons were all labeled with text. There were no special graphics within the program. Although there were long series of textual instructions, second and third grade children had no problem learning to use the software. This points out that an underlying assumption of most developers of children's software needs to be discarded. Currently, the term "multimedia" is used interchangeably with "software" in discussing how computers can be used in education, suggesting that a program must employ more than one medium to be real software. As Amy Bruckman, developer of the textual MOOSE Crossing system, points out, "A media type should be chosen by analyzing the unique requirements of each design situation. ... The benefits of text need to be explained to people seeing it for the first time; graphics are more immediately accepted." (Bruckman 1997) If the software being developed is for writing, it makes sense to use text extensively, perhaps even exclusively. Substituting pictures of bugs for menu titles, as is done in one popular children's writing program, is cute but does not enhance the usability of the software or its suitability as a writing environment.

The issue of how much formatting ability a children's writing program should have is complex. Whole-language advocates would approve of programs that employ drawing, extensive font control, and numerous other formatting functions. These features would allow the computer to be a medium for the sort of writing children do at other points in the classroom, since this educational approach encourages children to think of expressive scribbling and drawing as forms of writing. Even if one does not hold with this view, it is important to consider formatting ability since layout and text style features are very important to children. Formatting can be a distraction from the fundamental writing process used by adult writers, which is about putting words one after another, not about page layout and font selection. Still, some children use the formatting features of the software extensively for useful purposes. For example, they make the text larger to make it more readable, and examine the on-screen pagination to gauge how much they have written. Some of the children who employed the formatting features the most and complained most vehemently about their absence from the three programs in the study also wrote lengthy, high-quality stories. Others played with these features rather than writing.

It is important to give children good tools for writing and to give them reasonable and appropriate control over the appearance of the text. Designers should be careful to make sure all formatting features are included to help the writing activity, however. For instance, there is a compromise between not allowing children to control the size of the font at all and giving them full text formatting ability. The program might let users raise the font for the entire document, but not provide a function for formatting individual bits of text. This would allow users to make their work easier to see while not distracting them with excess

formatting ability. This particular feature may not be an ideal one, but it demonstrates how designers might find a middle road between a full-featured page-layout program and a stripped-down text editor. In deciding what formatting functions should be included, developers must consider the overall language-learning philosophy to which they adhere, the focus on the writing task, and the desirability of these features to children.

Ease of use is essential to the success of software for creative writing. Children are very good at figuring out how hard-to-use software works, but the difficulties they encounter along the way can overwhelm the educational benefit of additional features. Commercial programs to help children write have few innovative features but have been designed very well and are well-tested. Their ease of use can be a bigger help to young writers than an innovative educational intervention that is fundamentally sound but poorly implemented.

Observation of students in this study reaffirmed that children will always find new uses for software, explore hidden “features” that adults would never think to use, and generally reappropriate the program for their own purposes. A story-writing program will be used to write things other than stories, no matter how well it conforms to the story-writing task and no matter how hard developers try to keep it from having other uses. The best a software developer can do is keep this in mind when creating the program, and make sure that the program is stable and suitable for its main purpose.

Finally, the original sequential plan/write/revise model did not adequately capture the flow of the writing process. Even when learning about the writing process, writers do not finish all of their planning before writing a word of their story. They engage in editing and revision behavior while they are writing instead of waiting until afterwards. Children found ways to cope with this inadequacy of the programs in the study, circumventing the usual progression by starting over or continuing to write after they had gone through the revision stage. Fortunately, the program was flexible enough so this deficiency in its model of the writing process was not an insurmountable barrier to effective writing. In general, irreversible progression through phases is a bad idea in creative writing software. The improvements to EddieEdit and StoryStages were made with this in mind.

Improving Future Evaluation Methods

There is a fundamental difficulty in evaluating the writing quality of a group of students before and after an educational intervention. If the two evaluations are separated by a short time, as in this two-week study, there may be little discernible improvement. This problem is worsened in the case of story writing, where children can write about any topic and do not benefit from quick organizational lessons that may help essay writers. If the evaluations are months or a year apart, however, factors extrinsic to the educational intervention may overwhelm its effect. A suitable time frame for evaluating creative writing improvement would probably be more than a month and less than a year. The longer time would also allow children to use the software often — perhaps two or three days a week — but not have to be subjected to daily use, which can be tiresome. Less frequent use over a longer period of time could make for a better study, one which yields clearer results and maintains the motivation of the students who are writing.

The evaluation of writing ability should be done under identical conditions in a more formal atmosphere. The enthusiasm of the students was great during the first writing session since they were beginning the study. During the final session this enthusiasm had been almost completely dulled, and students did not want to write any more. It would help to separate both the initial and final writing sessions from the main part of the study by at least a week. The sessions should not be linked to anything that might cause excitement or resentment. It would also improve results if a more formal testing atmosphere were established in which teachers did not provide help and students did not distract each other. Despite the dampening effect this may have on some students' creativity, it is necessary so evaluators can produce two measures of writing ability that can be compared. The initial and final evaluations should ideally each consist of more than one writing session in which students each produce more than one story.

Relatively unconstrained evaluation by story experts seems to be a fairly good method of determining writing quality, since two evaluators working independently came up with scores that were rather highly correlated. The method could be improved upon by having the experts consult each other and agree on criteria independent from the educational intervention being studied. Although the story experts who evaluated writing samples in this study had different criteria, they shared many of the same principles. It seems likely that they could agree on criteria and apply those criteria fairly consistently to story writing samples. The evaluators also probably had difficulty evaluating unfinished stories. The presence of resolution and an ending are important features of a story mentioned in their criteria. If students were given more time and told to write a story from start to finish, evaluation would be easier and more accurate. Length in words has been used to measure writing ability in prior studies. Even without the formulation of shared criteria, evaluation by experts appears to be a better measure of creative writing quality than length in words.

SOFTWARE DEVELOPED

Two Macintosh programs and a Web version of Eddie's planning conversation resulted from the work described in this paper. The main point was to demonstrate the viability of a conversational computer character to aid in creative writing, thus encouraging additional research into this type of educational intervention. This study should also encourage other developers to integrate conversational characters into software that has been designed with the writing process in mind. EddieEdit, however, already embodies a simple but functional character and can be of use now to educators and students.

StoryStages is a functional program that allows children to plan and revise as well as write. It is personality-free and does not simulate conversation, so it does not provide the educational benefits of a computer character. It does prompt children to think about planning and revising as well as writing, although not as effectively as EddieEdit. Still, StoryStages may be a good program for those who want the benefits of these prompts but do not wish, for whatever reason, to use EddieEdit.

EddieEdit is the first story writing program for children to employ a conversational computer character who helps with the planning and revision processes in story writing. The character Eddie is not the most responsive, knowledgeable or detailed, but he is a

character and can help students by conversing with them. Although the author hopes that more advanced characters will be developed soon, EddieEdit can benefit young writers now by increasing their awareness of the writing process, since it is currently available for classroom and home use. The program should also serve as a useful example of how even a simple computer character can effectively converse with children about writing.

The Web version of Eddie can be used by anyone with Internet access and a browser.¹¹ This version, which offers only the planning conversation and is not integrated with a word processor, is mainly intended to show other developers, researchers, and educators what Eddie is like and how he interacts. Although the Web version has limitations, accessing Eddie on the Web is quicker than downloading EddieEdit. Even though access to the Web version from school will not be widespread, a few young writers who use the Web at school or home might find this version of Eddie useful.

AREAS FOR FUTURE WORK

Clearly a longer-term study with thorough initial and final evaluations of writing ability would be of use. Further development of conversational character systems is warranted even before such a study is conducted, however. The final version of EddieEdit corrects many of the usability problems of the earlier version, but Eddie himself could be made more responsive and further interface refinements could be made. Additional development of conversational character features and of the interfaces of both a comparison system and a character system should be undertaken. The conversational abilities could be extended without adding “intelligence” by employing knowledge representation and in-depth semantic understanding. The conversation system could use better pattern matching to determine when the user is giving a “not applicable” reply. The conversation engine could also detect short, repeated replies (such as “ok”) that might indicate lack of interest in the conversation. Employing limited “intelligence” in the form of semantic and syntactical analysis could also be beneficial, if such improved linguistic ability on the part of the character is actually used to enhance communication and aid the user in planning and revision. A system incorporating improvements like these would make for a larger potential difference between user groups and be more likely to produce results with significance. After improved software has been developed, long-term studies with more students can help to determine whether a conversational computer character helps students improve more than their peers who do not use such a character.

Additional development should also focus on how to effectively communicate the characteristics of the conversational character. Although Eddie was a fairly well-defined personality as text-based computer characters go, children did not get a good impression of who he was. The icon of Eddie alone may focus them on Eddie’s character and invite them to learn more about who he is, and new programs should employ minimal graphics of this sort when appropriate. In EddieEdit, too much discussion of who Eddie is could distract from the story planning task. Eddie’s traits and personality should have been more effectively interwoven into the conversation and the advice he gives, so students will realize

¹¹ Eddie is currently at (<http://paradise.media.mit.edu/eddie>).

he is not just a “story helper” but also a kid editor. New programs should be attentive to character development and to effective communication of the character that is developed.

The conversational abilities and representation of character could be certainly be enhanced by having the character manifest itself and converse in additional media, such as sound and animation. This author thinks that, just as drawing software should use mainly graphical media, writing software should use mainly text. Still, it may be possible to enhance the central, textual task by giving a character facial expressions, gaze behavior, and gestures, either to represent emotion or to support conversation with more subtle, foundational behaviors. To fully explore the possibilities of such a character, researchers should create software using varying amounts of animation. Studies should be undertaken to compare the specific effects of different sorts of characters (for instance, animated and non-animated, speaking and non-speaking) on the particular activity of elementary school creative writing.

Eddie is but one type of character who discusses writing in one way, talking about specific story elements. Other characters should be developed that have different personalities and talk about different things. A different character might ask the student for help in writing a story, reversing the relationship. Another character might ask the student only about plot, or only about a topic, or prompt the writer only to visualize or only to free-associate. One character might even be a troublemaker, delivering quick and appropriate replies to the short answers and violent topics that some elementary students offered to Eddie. Asking about story elements is traditional, but it is certainly not the only approach. A character who is upbeat and knowledgeable is also typical, but other sorts of character may be more engaging and effective. Ideally, students should be given a choice of what type of character they wish to talk to and what type of discussion they wish to have.

Another important consideration is how a conversational computer character should be integrated into software that uses several effective educational interventions. A naive computer character that does not examine the story the user has written could exist alongside grammar-checking, style-checking, and spell-checking tools. There should, however, be special consideration of how such features might be best integrated. Some may find it better to educate the computer character and have students use that character as a uniform planning, revising, and editing interface.

Finally, developers and educators need to consider together how the use of a conversational computer character might fit into their own educational philosophy and teaching strategy. Those who see the computer as more of a tutor might consider developing characters that not only stimulate thinking but also directly instruct. Others might create characters who suggest topics for stories, rather than just asking about structure and story elements. Although such approaches were avoided here because of the author’s educational goals and beliefs, the effective intervention of a conversational computer character can be employed by others who do not share the same overall outlook. Even those who agree with this outlook need to consider how a conversational computer character can work with other parts of the language arts curriculum. The character could, for instance, discuss reading as well as writing, giving examples of effective use of story elements (if they are the topic of the planning discussion) in some of the user’s favorite stories. A conversational computer character can — with additional research, further work from educational software

developers, and the support of teachers — play a meaningful role in elementary creative writing education and make a difference in the language arts classroom.

APPENDIX A: STUDY DOCUMENTS

The following documents are the ones given to student subjects and story evaluators in the course of the study. The “Survey” pages are the beginning and ending questionnaires given to the students. Different final surveys were given to the different groups, since it would reveal little if children in the word processor group were asked “Who is Eddie?” The “Instructions for Evaluators” page contains all the instruction given to the two story evaluators.

Beginning Survey

(For the Study "Evaluation of Software to Help Children Write Stories")

I have some new computer software I would like you to try. This software is for writing stories. It's supposed to make it easier to write good stories. I would like to look at the stories you write with it so I can see how well the software works.

Here are some questions for you that will also help me figure out how well the software works. Please circle the letter that best answers each question. It would help me if you answer them, you don't have to. This isn't a class assignment. If you do answer, I won't show your survey to anybody else.

1. Have you used computers before?

- A. Nope.
- B. Yes, but just a little.
- C. Yes, once in a while.
- D. Yes, a lot.
- E. Yes, all the time!

2. Do you have a computer at home?

- A. Yes.
- B. No.

3. What have you used computers for? Circle ALL the things you've done on computers.

- A. Computer games.
- B. Writing Stories.
- C. E-mail.
- D. Drawing pictures.
- E. Learning to type.
- F. Looking at things on the Internet.
- G. Other things: (Write in the other things.)

4. Do you like to use computers?

- A. No, I hate computers.
- B. Not very much.
- C. I like computers a little bit.
- D. Yes, they are pretty fun.
- E. Yes, I love using computers.

5. Have you written stories before?

- A. No.
- B. A few.
- C. Yes, some.
- D. Yes, many.
- E. I've written very, very many.

6. Do you like to write stories?

- A. No, I hate writing stories.
- B. Not very much.
- C. I like writing stories a little bit.
- D. Yes, writing stories is pretty fun.
- E. Yes, I love to write stories.

7. How do you write them?

- A. I tell them and somebody writes them down.
- B. I use a pen or pencil.
- C. I type them on a computer.
- D. Some other way: (Write in what way.)

Red Group Ending Survey

(For the Study "Evaluation of Software to Help Children Write Stories")

Thanks for helping me by using the software in your story writing! If you would also answer these questions, it would help me figure out how well the software works. Please circle the letter that best answers each question, or write the answer under the question. Again, you don't have to answer the questions if you don't want to, and I won't show your survey to anybody else.

1. Did you like the program you used for writing?

- A. No! It was lame.
- B. No, it wasn't that great.
- C. It was OK — nothing special.
- D. Yes, it was pretty good.
- E. Yes! It was really great!

2. What was your favorite thing about it?

3. What did you really NOT like?

4. Would you want to use that program at home?

- A. No way!
- B. Not really.
- C. Maybe, once in a while.
- D. Yes, I'd use it some.
- E. Yes! I'd use it a lot!

5. How could that program be better?

6. Did that program make it easier for you to write stories?

- A. Yes.
- B. No, it was hard writing with the program.
- C. No, writing stories was already easy for me.

7. Do you think it made it easier for the other children in your group to write stories?

- A. Yes.
- B. No.

Green Group Ending Survey

(For the Study "Evaluation of Software to Help Children Write Stories")

Thanks for helping me by using the software in your story writing! If you would also answer these questions, it would help me figure out how well the software works. Please circle the letter that best answers each question, or write the answer under the question. Again, you don't have to answer the questions if you don't want to, and I won't show your survey to anybody else.

1. Did you like the program you used for writing?

- A. No! It was lame.
- B. No, it wasn't that great.
- C. It was OK — nothing special.
- D. Yes, it was pretty good.
- E. Yes! It was really great!

2. What was your favorite thing about it?

3. What did you really NOT like?

4. Would you want to use that program at home?

- A. No way!
- B. Not really.
- C. Maybe, once in a while.
- D. Yes, I'd use it some.
- E. Yes! I'd use it a lot!

5. How could that program be better?

6. Did that program make it easier for you to write stories?

- A. Yes.
- B. No, it was hard writing with the program.
- C. No, writing stories was already easy for me.

7. Do you think it made it easier for the other children in your group to write stories?

- A. Yes.
- B. No.

8. What does "revision" mean?

9. What are two things you think about when you plan a story?

Blue Group Ending Survey

(For the Study "Evaluation of Software to Help Children Write Stories")

Thanks for helping me by using the software in your story writing! If you would also answer these questions, it would help me figure out how well the software works. Please circle the letter that best answers each question, or write the answer under the question. Again, you don't have to answer the questions if you don't want to, and I won't show your survey to anybody else.

1. Did you like the program you used for writing?

- A. No! It was lame.
- B. No, it wasn't that great.
- C. It was OK — nothing special.
- D. Yes, it was pretty good.
- E. Yes! It was really great!

2. What was your favorite thing about it?

3. What did you really NOT like?

4. Would you want to use that program at home?

- A. No way!
- B. Not really.
- C. Maybe, once in a while.
- D. Yes, I'd use it some.
- E. Yes! I'd use it a lot!

5. How could that program be better?

6. Did that program make it easier for you to write stories?

- A. Yes.
- B. No, it was hard writing with the program.
- C. No, writing stories was already easy for me.

7. Do you think it made it easier for the other children in your group to write stories?

- A. Yes.
- B. No.

8. What does "revision" mean?

9. What are two things you think about when you plan a story?

10. Who is Eddie?

Instructions for Evaluators

The packet has 36 pages of story writing from children in grades 2 and 3. Children were given 40 minutes and simply asked to “write stories.” No subject matter was specified, and it was not specified whether the stories should be fictional or personal. They were told it was OK if they did not finish. Some did finish their stories. Others wrote the beginning of a story, and a few wrote parts of more than one story. Everything they had written at the end of the session is included on the pages. Only the names of the writers have been removed for the stories in this packet.

I would like you to evaluate the story writing samples. I ask that you first read through the whole packet to get an idea of the range of writing the children have done. Then, please look at each page individually and rank the writing sample there from 1 to 10. 1 represents the lowest story writing quality of the group, and 10 represents the highest story writing quality. These rankings are in comparison to the other stories in the group. So there should be at least one page — the worst — that is ranked 1, and at least one page that is ranked 10. A story that is of about average quality compared to others in the group should be ranked 5 or 6 (since 5.5 would be halfway between 1 and 10). When you finish, compare a few stories that differ by only one point to check that your evaluation is consistent throughout the sample.

I ask that you evaluate how good the writing sample is in terms of **story writing**. Please select your own specific criteria for evaluation, based on what you think are qualities of good story writing. I only ask that you use criteria that are neutral with regard to specific subject matter. In other words, writing about a subject which is of personal interest to you should not be ranked higher than writing about a subject that is personally displeasing to you, if the writing is in otherwise equal in quality. I will ask you when you are done what criteria you used.

I will explain to you how these rankings are being used in my analysis after I have received your evaluations and when am sure I will have no further questions about your evaluation criteria or your individual rankings.

If you have any questions about how the evaluation should be done, please email me with those questions and I will reply to both of you.

As I have already mentioned, I greatly appreciate your help.

APPENDIX B: TRANSCRIPTS

These are transcripts of what some StoryStages and EddieEdit users wrote during part of the study. For the two StoryStages sessions, this includes the prompts and written responses for both planning and revision. For the three EddieEdit sessions, this includes the planning and revision conversations with Eddie. In all cases, the finished story is also included. The interactions each spanned more than one day's writing session.

STORYSTAGES

PLANNING

1. What are some things you would like to write a story about? List a few things that come to mind.
Murder,killing,talk of murder,drugs,alcohol,Sex
2. Now, look at the list above and pick some ideas. Decide what your story is going to be about. It can be about more than one thing.
Teen gets kicked out when 16,gets revenge by murder.
3. If you like, give your story a working title. You can change the title later if you want to.
TeenKill
4. Who is going to be the main person in the story - the main character?
Robert,the teen
5. If there are going to be other characters, who are they?
Charles M Shauz and Jessica M Shauz,the millionares,Franz,the butcher,Matt,the butler.
6. Where will the story happen?
Washington D.C.
7. What does this place look like?
After WW2,how do you think it would look?
8. When will the story take place?
1944,after WW2
9. What will be happening at the beginning of the story?
Robert gets born, and he has a horriable apperance
10. What will happen to the characters during the story, or what problem will come up for the characters to deal with?
They get killed,ETC,and Robert comes face-to-face with a family problem:Love
11. What are they going to do? How will they act when that happens, or how will they solve the problem?
Remembering themselves as young,and the characters can't do anything;they are dead
12. Why will the characters do that?
I already told you:They can't do nuttin'!!
13. When the main event in the story happens, how do the characters feel?
DO YOU HONESTLY WANT ME TO GO NUTS???!!!
14. How will the story end?
Robert meets his real father and gets married to Annie
15. How do the characters feel at the end of the story?
Melencholy.

REVISING

[did not enter revision mode]

STORY

[no story text written]

STORYSTAGES

PLANNING

1. What are some things you would like to write a story about? List a few things that come to mind.
fantasy, history, fiction, nonfiction, An adventure
2. Now, look at the list above and pick some ideas. Decide what your story is going to be about. It can be about more than one thing.
fiction, an adventure, history
3. If you like, give your story a working title. You can change the title later if you want to.
4. Who is going to be the main person in the story - the main character?
Me
5. If there are going to be other characters, who are they?
My mom & some creatures that lived in the past centuries
6. Where will the story happen?
Inside a galaxy-like thing that scientists made up otherwise earth
7. What does this place look like?
[no reply to this prompt or any later prompts]

REVISING

[no reply to any revision prompts]

STORY

Trapped in the 4 dimensions

One fine evening scientists attached the're little iventary workshop to our house we heard a lot of ka-chink's & crank's it was awful & the saying "one fine evening" wasn't relly fine. That night I hardly got any sleep I went downstairs to see what all the racket was. All the sudden a big machine came sweeping into the stairs it grabbed me & through me into a big whirlpool in the house & the last thing I remembered was a big machine grabbing me with it's mechanical arms it was horrible (this time) I yelled HHHHHHHHHHEEEEEEEEEEEEEELLLLLLLLLPPPPPPPPPP!!!!!!!!!!!!!!!!!!!!!! my ears were shrinking ,my arms were shrinking & my legs were stuck together I was nothing but a flat line the machine was charging at me at lightning speed & the machine also turned into a flat line I made my feet into a triangle & swordfoughted . I looked around "There is the whirlpool" I thoght. without thinking I jumped in I'd do anything to get out of there . But to my suprise I was still flat but I wasn't a line but I could turn into anything I wanted to be & that was better I turned into a flat vicous virus " asta la vista amigos" I said just then I rememberd it was a machine " Oh man" I said" I got prepared for nothing now I have to start all over agian" . This time the machine wasn't a machine just a wierd thing with buttons walking around in circles. I laughed & said "dumb" I wanted to do something but all I wanted to see was the whirlpool to reappear I'm stuck here for good this time I thought but then I thought of what to do could I draw? I thought. I became a FLAT pencil & began to draw the thing with buttons was still cranking around maybe if I destored the device (which was the machine) I could-then the whirlpool was there I jumped in the whirlpool the machine followed finelly I was 3D & so was the machine "this sucks am I suupposed to learn a lesson here" I began drawing again I was just in the middle of my picture about my adventures the machine beeping happilly like R2-D2 "he always thinks he someone else" I said. "hey machine I'm going to teach you a leason you will never forget" I went charging at the machine at lightning speed when the machine held out his machanical arm without at me & I got hit on the forehead & I fell down to the ground right on my picture.....an hour later I was asleep & the machine picked me up the picture stuck to my back the machine shook me & I woke up & the picture fell down & when I looked down I saw that the picture tolltely damoleshed & destrored I began drawing again this time I drew a whirlpool & my picture became ALIVE!!!! I got sucked in so did the machine I was myself again "I must be in the 4th dimension" I thought this time I tried something I never tried before but it was worth a try. I tried to get to the exstensions of the machine but I figerd out that I would be

trapped if I pulled out the exstensions because it was inside the machine which lead to the part of what created the time-like-sort of planet thingy that would domolesh the human inside it so I didn't do it.I looked at my picture,it didn't have a lot of detail to it so I drew some more I missed my mom & dad so I looked at my watch it was7:30"my mom &dad should want me home by now "I thought then I looked at the machine it was doing somthing funny it looked like it was tring to talk"wierd"I said the whirlpool was right on the bottem of me & the machine & I returned home safe & sound "where were you Mark?"

EDDIE EDIT

PLANNING

EDDIE: Hi! I'm Eddie. What's your name?

USER: [student's name]

EDDIE: Nice to meet you. I'm the editor of my elementary school's magazine. I help people write stories. Do you like to write?

USER: YES

EDDIE: Great! I like writing too. Before I write a story, I plan it. First, I think of all my ideas. What things do you want to write about?

USER: A GUY CALLED FREAKAZOID

EDDIE: OK. The next thing I do is decide what my story will be about. What things from your list do you want to write about?

USER: A GUY NAMED FREAKAZOID

EDDIE: Now that you know what your story is about, it's a good time to pick a title. You can change the title later if you want. What's your title?

USER: FREAKAZOID

EDDIE: OK. Now we can talk about parts of the story. Now do you want to talk about the characters, the place, the time, or the things that happen?

USER: THE CHARACTERS

EDDIE: Who is going to be the main person in the story - the main character?

USER: FREAKAZOID

EDDIE: Are there going to be other characters? Who are the other characters?

USER: CYB FACE

EDDIE: Now do you want to talk about the place, the time, or the things that happen?

USER: THEPLACE

EDDIE: Sorry, I didn't understand. Now do you want to talk about the place, the time, or the things that happen?

USER: THE PLACE

EDDIE: Where is the story going to happen?

USER: BROOK LINE

EDDIE: What does this place look like?

USER: MANY TALL BILLDINS

EDDIE: Now do you want to talk about the time, or the things that happen?

USER: THE TIME

EDDIE: When will the story happen?

USER: 2000

EDDIE: At the beginning of the story, what will be happening?

USER: I DON'T KNOW

EDDIE: What problem is going to come up for the characters to deal with?

USER: I DON'T KNOW

EDDIE: How will the characters solve the problem?

USER: I DON'T KNOW

EDDIE: How will the story end?

USER: I DON'T KNOW

EDDIE: Why will the characters do the things they do to solve the main problem in the story?

USER: I DON'T KNOW

EDDIE: In the middle of the story, when the problem comes up, how do the characters feel?

USER: WERID

EDDIE: How will the characters feel in the end?

USER: FINE

EDDIE: I think we talked about all the parts of a story! I've got go for now. Go ahead and start writing. You can look back at the plan you made.

USER: OK

REVISING

[did not enter revision mode]

STORY

Hi I'm Freakazoid this is how it startid. Hey come back here Cyb face never!!!!!!.& then I said oh yes you will. Kyb face. Thats cyb face you niingcapoop!!! Don't call me a ningcompoop you ideeit!@#\$\$%^&*!@. Ok freekazoid. o freekout. Thats the freekcall that somins the freek mobeele. Then cyb face was piked up by his robot hot roders and drov intothe ochin the end

EDDIEEDIT

PLANNING

EDDIE:Hi! I'm Eddie. What's your name?

USER:[student's name]

EDDIE:Nice to meet you. I'm the editor of my elementary school's magazine. I help people write stories. Do you like to write?

USER:yes

EDDIE:Great! I like writing too. Before I write a story, I plan it. First, I think of all my ideas. What things do you want to write about?

USER:pepole that are lost in cyber space

EDDIE:OK. The next thing I do is decide what my story will be about. What things from your list do you want to write about?

USER:Action

EDDIE:Now that you know what your story is about, it's a good time to pick a title. You can change the title later if you want. What's your title?

USER:LOST IN CYBER SPACE

EDDIE:OK. Now we can talk about parts of the story. Now do you want to talk about the characters, the place, the time, or the things that happen?

USER:YES

EDDIE:Sorry, I didn't understand. Now do you want to talk about the characters, the place, the time, or the things that happen?

USER:yes i do

EDDIE:Sorry, I didn't understand. Now do you want to talk about the characters, the place, the time, or the things that happen?

USER:Y

EDDIE:Sorry, I didn't understand. Now do you want to talk about the characters, the place, the time, or the things that happen?

USER:Yes

EDDIE:Sorry, I didn't understand. Now do you want to talk about the characters, the place, the time, or the things that happen?

USER:ok

EDDIE:Sorry, I didn't understand. Now do you want to talk about the characters, the place, the time, or the things that happen?

USER:characters

EDDIE:Who is going to be the main person in the story - the main character?

USER:Zeak

EDDIE:Are there going to be other characters? Who are the other characters?

USER:Zack mike spike

EDDIE:Now do you want to talk about the place, the time, or the things that happen?

USER:the time

EDDIE:When will the story happen?

USER:1999

EDDIE:Now do you want to talk about the place, or the things that happen?

USER:theplace

EDDIE:Sorry, I didn't understand. Now do you want to talk about the place, or the things that happen?

USER:the place

EDDIE:Where is the story going to happen?

[conversation continues but saved information ends here]

REVISING

EDDIE:Well, let's talk about what changes might be good to make. Let me ask about the beginning of your story. Do you think your first sentence is really good?

USER:yes

EDDIE:Great! If you make it better it will be really super. If you want to, try to write one that is even better.

USER:make a new sentence

EDDIE:OK, now let's talk about the end. That's what the reader will remember the most! Do you think the ending is really good?

USER:yes

EDDIE:Great! But if you make it better it could be the best story ending ever. If you want to, try to write and ending that is even better.

USER:make a new sentence

EDDIE:OK, now let's talk about characters - and how they feel and think. I'm sure you wrote about what the characters do. Did you also write about how they feel, and what they are thinking?

USER:yes

EDDIE:That's very good! That's what makes characters seem real. If you want to, you can write more about how they think and feel.

USER:no I don't

EDDIE:OK. Now, read your story. Is everything that happens very clear? Sometimes it helps to add some sentences to explain. That can make the story easier to understand. What could you add?

USER:I don't know

EDDIE: Well, that's about all I can tell you. Go over to the story window now and make all the changes you want to make. Then, come back and tell me: How many changes did you make?

USER: ok

EDDIE: Any changes you make can make the story better. I have to go now. I hope I helped you a little. Bye!

STORY

One day in bostin at the gallery Zeak Zack and mike were chasing spike with there pistil`s. They went up 10 flors and beet spike to the 10th flor by elavader. They shot up the elavader door and ran out then some polece and FBI ajents came in. They shot at Zeak but they missed him. They ran up to the roof. Then they were in cyber space. They juped of a computer chip into the bit streem onto some cerkit speeders. The cop`s and F.B.I. pepole crashed into the wall. Then Zeak shot Spike down and throo a rope a round Spike. Then Spike was throun out of cyber space and into jall.

The End

EDDIE EDIT

PLANNING

EDDIE: Hi! I'm Eddie. What's your name?

USER: hurr

EDDIE: Nice to meet you. I'm the editor of my elementary school's magazine. I help people write stories. Do you like to write?

USER: vf

EDDIE: Well - Hey, Billy does not know more dinosaur names than me! Sorry, someone else was talking to me. What were we talking about?

USER: g

EDDIE: I think we were talking about writing stories. I like to plan my stories. First, I think of all my ideas. What things do you want to write about?

USER: ty

EDDIE: OK. The next thing I do is decide what my story will be about. What things from your list do you want to write about?

REVISING

EDDIE: Hi again! I guess you wrote your story. I have a few more questions that might help you. Have you ever made changes to make one of your stories better?

USER: ghj

EDDIE: Well, let's talk about what changes might be good to make. Let me ask about the beginning of your story. Do you think your first sentence is really good?

USER: Yes

EDDIE: Great! If you make it better it will be really super. If you want to, try to write one that is even better.

USER: ok

EDDIE: OK, now let's talk about the end. That's what the reader will remember the most! Do you think the ending is really good?

USER: rt\

EDDIE: Um ... sorry, I didn't understand. But anyway, you can always try to make the ending better. If you want to, try to write a better ending now.

USER: khj

EDDIE: OK, now let's talk about characters - and how they feel and think. I'm sure you wrote about what the characters do. Did you also write about how they feel, and what they are thinking?

USER: ffg

EDDIE: Um, er, well, if you didn't write anything about how your characters feel, your characters won't seem real. Try writing something about how the main character feels at the beginning or at the end.

USER: lk

EDDIE: OK. Now, read your story. Is everything that happens very clear? Sometimes it helps to add some sentences to explain. That can make the story easier to understand. What could you add?

USER: hgf

EDDIE: Well, that's about all I can tell you. Go over to the story window now and make all the changes you want to make. Then, come back and tell me: How many changes did you make?

USER: iuuy

EDDIE: Any changes you make can make the story better. I have to go now. I hope I helped you a little. Bye!

USER: khh

STORY

[name of student in class] and the Science Movie

once [name] was walking along when he saw a sign on the top of the movie theater. It said:

New film out! Space science!

Coming to a Theater near you

[name] said "I have got to see that" and made a mental note to ask his mom. when he got home and asked his mom said "how about next weekend"? It was monday [name] could hardly hear his anticipation! The movie's rating was Five star! In school,[name]'s class was working on their CAT tests. [name] was looking for a perfect score so he could impress his mom to raise the chances of him watching the movie. That day his 3rd grade was doing the math portion of the test. [name] thought he did pretty good the next day was tuesday and when he got home, he did his homework and played Civilization 2 on his computer. when it was time to go to bed [name] could hardly sleep because he was so excited about the movie. When Saturday finally came, [name] saw the movie it was great.

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